University of Alberta

Understanding Women's Risks for Injury From Sexual Assault

by

Catherine Joan Carter-Snell ©

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ABSTRACT

Presence of physical injuries from a sexual assault has been linked to the development of significant long term psychological and physical health consequences in women. Effective prevention of consequences requires an understanding of injuries and risks for injuries yet the literature on risks for injuries is inconsistent. The purpose of this research was to examine the evidence regarding rates and severity of injuries and the influence of various risk factors on injuries.

A systematic review was conducted of studies involving sexual assault injuries and effects of risk factors. Categories of injury varied across the 43 studies included (e.g.- genital, nongenital and physical) as did the definitions of injuries. Rates of genital injury were higher among sexual assault nurse examiners (SANEs) compared to physicians, especially if aids to visualize genital injury were used. Rates of nongenital injury were higher if the exam was conducted by an emergency physician versus SANEs, or if women reported to police. Nongenital injuries tended to be more severe but genital injuries were more numerous. The risk factors associated with genital injury differed from those associated with nongenital injury.

A theoretical model was developed to explain the association between various risk factors and genital or nongenital injury outcomes. The model was tested using data from 485 women seen by an urban sexual assault team. Physical aggression had the largest effect on the severity of nongenital injuries and was increased if women were more awake, used physical resistance, or did not know the assailant. It was also increased if the setting was more public and the assailant used verbal aggression. Nongenital injury was more severe if there was attempted versus completed penetration. Genital injury severity

was increased with completed anal penetration or multiple sites of penetration and if women were more conscious.

Further research is needed, including validation of the model and testing of the influence of various risk factors on injuries in different sexual assault populations and settings. In order for this research to be meaningful, sexual assault examiners need to begin using standard examination practices, consistent injury definitions and collect data on similar sets of risk factors.

DEDICATION

"And if I have prophetic powers, and understand all mysteries and all knowledge, and if I have all faith, so as to remove mountains, but have not love, I am nothing." (1 Corinthians 13; 2, ESV).

This dissertation is dedicated to my friends, family and students. Their love and support has been instrumental in my completion of this research.

My parents, Bill and Joan Carter, have always believed in me and taught me that anything can be achieved if you try. My husband, Mark Snell has been there through two graduate degrees, providing laughter, encouragement, more than his share of housework and child care, and computer advice. My children, Christopher and Caroline Snell, have helped me to remember balance in my life and to value the beauty in each day. My sisters Barb, Susan and Judy, along with their families have been there to support me (and keep me humble).

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TABLE OF CONTENTS

CHAPTER 1: UNDERSTANDING WOMEN'S RISKS FOR INJURY FROM SEXUAL ASSAULT 1
  Literature Review 3
    Sources of Variability 4
  Purpose of the Research 7
  Organization of the Dissertation 8
  References 10
CHAPTER 2: SYSTEMATIC REVIEW OF WOMEN'S RISKS FOR INJURY 15
  FROM SEXUAL ASSAULT 15
  Literature Review 16
  Methods 19
    Search Strategy 19
    Selection of Risk Factors and Outcomes 21
    Inclusion Criteria 21
    Definitions 22
    Interrater Reliability 23
    Study Assessment 24
    Data Extraction 26
    Data Analysis 27
  Results 27
    Interrater Reliability 29
    Included Study Characteristics 29
    Study Quality 35
  Results 39
    Injury Outcomes 39
    Factors Influencing the Rate of Iinjury 47
    Biographic Risk Factors for injury 52
    Contextual Risk Factors for Injury 60
    Assault Risk Factors 62
  Discussion 69
    Quality of the Evidence 69
    Injury Rates and Severity 70
    Factors Affecting Rates of Injury 72
    Influence of Risk Factors on Injury Outcomes 74
  Limitations 80
  Implications 80
    Practice 80
    Education 81
    Research 82
  References 84
CHAPTER 3: MODELING WOMEN'S RISKS FOR INJURY FROM SEXUAL ASSAULT 95
  Background 96
    Methods of Analysis 96

        Injury Outcomes 97
        Measurement Issues 98
        Risk Factors 98
        Conceptual Model 102
    Methods 105
        Sample 105
        Measures 106
        Analyses 110
        Initial Estimation 111
        Model Modification and Results 114
        Relationships between Selected Risk Factors and Numbers of Injuries 118
    Discussion 121
        Effects of Risk Factors on Injury Outcomes 122
        Relationships Between Risk Factors 124
    Limitations 127
    Implications 127
    Conclusion 129
    References 130
CHAPTER 3: CONCLUSION 136
    Discussion 136
        Quality of the Evidence 136
        Injury Rates and Severity 137
        Factors Influencing Injury Rates 137
        Influence of Risk Factors on Injury Outcomes 138
        Relationship between Genital and Nongenital Injury 142
    Implications 143
        Practice 143
        Education 144
        Research 145
Appendix A: Detailed Injury Data 149
        Presence of "Physical" Injury (Genital, Nongenital or Both) 149
        Appendix A: Detailed Injury Data (Continued) 150
        Appendix A: Detailed Injury Data (Continued) 151
        Presence of Genital Injury -All 151
        Appendix A: Detailed Injury Data (Continued) 152
        Presence of Genital Injury –All (continued) 152
Appendix B: Sample Comparisons-Risks and Outcomes 153

LIST OF TABLES

CHAPTER 1: INTRODUCTION

Table 1-1. Haddon's Matrix and Sexual Assault Risk Factors..........3

CHAPTER 2: SYSTEMATIC REVIEW OF WOMEN'S RISK OF INJURIES FROM SEXUAL ASSAULT

Table 2-1: Risk Factors and Outcomes Used in Multivariate Studies.........21
Table 2-2: Included Study Characteristics 30
Table 2-3: MINORS Scale Ratings 36
Table 2-4: SASQ Scores 37
Table 2-5: Scores on MINORS and EVI by Year of Study 38
Table 2-6: Rate of Injuries across all Studies 41
Table 2-7: Injuries in Studies with Mutually Exclusive Categories 41
Table 2-8: Average Number of Sites of Injury 42
Table 2-9: More than One Injury (All Studies) 43
Table 2-10: Severity of Injury 43
Table 2-11: Outcomes after Sexual Assault 44
Table 2-12: Genital Injury Sites 45
Table 2-13: Nongenital Injury Sites 45
Table 2-14: Types of Injuries by Site 46
Table 2-15: Genital Redness and Swelling 47
Table 2-16: Tenderness and Pain with Physical Injuries 47
Table 2-17: Injuries Detected by Examiners-All Studies 48
Table 2-18: Injuries Detected by Examiners-Exclusive Injury Subset 49

Table 2-19: Examiner Type and Adjunct Use in Genital Injury Studies 49

Table 2-20: Injuries and Hours between Assault and Exam 50

Table 2-21: Injury Rates by Police Reporting Settings – All Studies 50

Table 2-22: Injury Rates by Police Report Settings- Exclusive Categories... 51

Table 2-23: Injuries by Decision to Report to Police 52

Table 2-24: Comparison of Genital Injuries if Reported vs Not Reported 52

Table 2-25: Injuries by Age 53

Table 2-26: Genital Injury and Prior Sexual Experience 56

Table 2-27: Age, Prior Sex Experience and Genital Injury 56

Table 2-28: Racial Group and Injury 57

Table 2-29: Genital Injury and Psychiatric Diagnosis 58

Table 2-30: Mean Number of Injuries by Substance Use 59

Table 2-31: Genital Injuries by Time of Day 60

Table 2-32: Injuries by Relationship to Assistant 61

Table 2-33: Physical Injuries by Relationship 62

Table 2-34: Force and Genital Injury 64

Table 2-35: Number of Assailants and Injury 66

Table 2-36: Injuries with Weapons 67

Table 2-37: Injuries with Sites of Penetration 68

Table 2-38: Genital Injuries and Object Used 68

CHAPTER 3: MODELING WOMEN'S RISKS FOR INJURY FROM SEXUAL ASSAULT

Table 3-1: Reasons for Exclusion from Study....................................106

Table 3-2. Injuries Types and Examination Results for Samples ….............112

Table 3-3: Variance-covariance Matrix for Final Model -Severity of Injury .114

Table 3-4. Unstandardized Direct Effects in Final Model -Severity of Injury 115

Table 3-5. Variance-covariance Matrix for Total Injuries 118

Table 3-6. Unstandardized Direct Effects of Final Model with Total Injuries 120

Table 3-7. Indicators in Regression Model in Order of Entry.....................121

CHAPTER 4: CONCLUSION

Table 4-1. Comparison of Injury Outcomes 137

Table 4-1. Comparison of Biographic Risk Factors...............................138

Table 4-1. Comparison of Contextual Risk Factors 140

Table 4-1. Comparison of Assault Risk Factors.....................................141

LIST OF FIGURES

Chapter 2: Understanding Women's Risk of Injuries from Sexual Assault

Figure 2-1. Flow Chart.. 28

Figure 2-2. Teen vs Young Adult Injuries 54

Figure 2-3. Older Adult vs. Young Adult Injuries 55

Figure 2-4. Prior Sexual Experience and Genital Injury Meta-analysis....... .57

Figure 2-5. Force and Genital Injury 65

Chapter 3: Modeling Women's Risks for Injury for Sexual Assault

Figure 3-1. Initial Conceptual Model 113

Figure 3-2. Final Fitted Model with Severity of Injury 117

Figure 3-3. Final Fitted Model with Numbers of Injuries 119

CHAPTER 1: UNDERSTANDING WOMEN'S RISKS FOR INJURY FROM SEXUAL ASSAULT

Sexual assault has been described as a "silent vicious epidemic" (Sommers & Buschur, 2004, p62). An epidemic is considered to be present when a health event or injuries are present in greater than expected numbers in a population (Merck Source, 2007). It is estimated that at least 4.3 million Canadian women aged 16 years or more have been sexually assaulted at least once in their lifetime, clearly making it an epidemic based on survey data (Federal/Provincial/Territorial Ministers Responsible for the Status of Women, 2002) and 2005 Canadian census data.

The health consequences of sexual assault are also significant. Women have higher rates of posttraumatic stress disorder and depression than men which has been attributed in part to sexual assault (Carter-Snell & Hegadoren, 2003). Posttraumatic stress disorder (PTSD) and/or depression have been found in 47 to 55% of women after a reported sexual assault (Foa & Riggs, 1995). PTSD is almost three times more likely for women who have been sexually assaulted compared to women who have not been assaulted (Acierno, Resnick, Kilpatrick, Saunders, & Best, 1999; Bromet, Sonnega, & Kessler, 1998). If women develop PTSD, their symptoms tend to be more severe and long lasting than men's and sometimes remain refractory to treatment (Foa & Street, 2001).

After a sexual assault there are also high rates of substance abuse (Meiser-Stedman, Yule, Smith, Glucksman, & Dalgleish, 2005; Michaels et al., 1999; Michaels, Madey, Krieg, & Long, 2001; Meiser-Stedman et al., 2005), increased sick days from work as well as use of health care services (Golding, 1999; Stein & Barrett-Connor, 2000; Stein et al., 2004), and increased suicide attempts (Butterfield, Panzer, & Forneris, 1999). The costs of these physical and psychological consequences for Canadian women are estimated to be between $300 million and $4.2 billion per year (Federal/Provincial/Territorial Ministers Responsible for the Status of Women, 2002). These costs include medical care, psychological care, lost days of work, and use of shelters and other support resources.

The scope and severity of the consequences highlight the urgent need for nurses to become involved in prevention. This cannot be achieved without an understanding of key factors involved in the development of consequences such as PTSD which may generate subsequent health disorders. Little is known about the pathways through which PTSD or depression develop after sexual assault. One key link to PTSD may be the presence of injuries from sexual assault. Women who sustained injuries have been found to be more likely to develop PTSD than non-injured women (Bownes, O'Gorman, & Sayers, 1991a). There may be common mechanisms associated with injury that lead to the psychological consequences associated with injury. Prevention or early identification of injuries from sexual assault may aid in reduction of the development of PTSD and perhaps other long term consequences.

Effective injury prevention efforts require an understanding of the complex forces at work in development of the injury. Haddon's matrix has been identified as a useful framework with which to identify and test strategies for injury prevention in nursing, particularly with epidemiologic data (Sommers, 2006). The model consists of examining three phases: pre-event; event; and post-event (Haddon, 1980; Runyan, 1998). For each phase there are four concepts to examine: host factors; agent of injury; the physical environment; and the sociocultural environment. The matrix is used in Table 1-1 to illustrate how various risk factors in the literature may be relevant.

Table 1-1

Haddon's Matrix and Sexual Assault Injuries

	Pre-Event	Event	Post-Event
Host Factors	Biographic factors: age, psychiatric history, disability, prior sexual experience	Substance use, level of consciousness	Outcome factors: Severity of injury, location of injury, type of injury
Sociocultural environment	Biographic factors: Race, values & , beliefs, income, education of victim	N/A	System factors: Values & beliefs of family, friends, health and legal personnel regarding injury and sexual assault
Agent of Injury	N/A	Assault factors: penetration, weapon use, multiple assailants, use of force, drug facilitated assault	N/A
Physical environment	N/A	Contextual factors: type of setting, assailant relationship to victim, assailant substance use	System factors: Availability of health services and counselling, support people, safety on discharge

Literature Review

An attempt was made to determine the role of risk factors on injuries and rates of injuries with a descriptive literature review. The focus of the review was on pre-event and event risk factors for injury and injury outcomes. There were many areas of inconsistency or discrepancy noted in the initial review.

The rates of injury from sexual assault varied in the literature depending on whether researchers reported the presence of "physical injury" or separated injury into "genital" and/or "nongenital". The rates of nongenital injury ranged from 30% to 76% and genital injury rates from 5% to 76% (Sommers, Schafer, Zink, Hutson, & Hillard, 2001). Furthermore, the risk factors for injury studied were not same across the literature, nor were their reported influences on injury consistent. Most of the research was descriptive, using univariate correlations or *t* tests for each variable in relation to injuries. Univariate tests may miss important relationships between risk factors that may lead to injury. There were a limited number of multivariate studies in which the interrelationships among factors are explored (Bownes, O'Gorman, & Sayers, 1991b; Cartwright, 1987; Crane, 2005; Hilden, Schei, & Sidenius, 2005; Sachs & Chu, 2002; Scott & Beaman, 2004; Sugar, Fine, & Eckert, 2004; Ullman & Knight, 1991). Additionally, the studies varied in the age of the women, the source of the data (e.g.- clinical observations versus police reports), the examiner type and technique, the risk factors studied and the injury outcomes measured making comparisons difficult. These studies were examined more closely in an attempt to identify sources of the variability.

Sources of Variability

In the small set of studies initially reviewed, the injury rates reported appeared to have been influenced by a number of factors. These factors included injury definitions, the definition of severity, populations, settings, experience of the examiner, and techniques used in examination may have affected both the reported injury rates associated with sexual assault and the results of studies regarding related risk factors.

Injury Definitions

Injury descriptions varied in their definition of location and types of injuries counted. Some researchers did not include redness or swelling in their injury definition (Adams, Girardin, & Faugno, 2001), which would result in a lower number of injuries, in comparisons to research team who included redness or swelling in their injury definition.

Adams, Girardin and Faugno (2001) also discovered differences in terminology for the same injuries. Physicians tended to refer to superficial lacerations as abrasions, while nurses referred to them as lacerations. Differences such as these may affect the perceived significance or severity of injury. Lacerations are associated with blunt trauma causing a separation of the layers of skin, while abrasions are associated with loss of superficial layers of skin from friction or pressure (Gall, Goos, Payne-James, & Culliford, 2003).

Definitions of Severity of Injury

Individuals who study sexual assault do not agree on the best way to define severity. Some use the number of injuries as a severity indicator, but as noted above, the number of injuries reported in the literature depends on how injury is defined. The presence of four bruises is not necessarily more severe as one head injury as would be implied by the number of injuries. There is a growing interest in trying to define severity in clinical terms. The Injury Severity Scale (ISS) is one of the most commonly used tools to rate multiple trauma (Pohlman, Bjerke, & Offner, 2007). The ISS is of limited use for sexual assault injuries as only the top three injured body regions are scored, there is a limit of three injuries, and genital regions are not scored. Despite its limitations, the ISS may provide direction for nongenital injury scoring but has rarely been studied with sexual assault. A few researchers have attempted to report mild, moderate or severe levels of injury with sexual assault, but the divisions are usually arbitrary and subjective. A group of Canadian researchers has developed and used a severity of injury index that offers a more objective strategy for assessing severity (Del Bove, Stermac, & Bainbridge, 2005; Dunlap, Brazeau, Stermac, & Addison, 2004; Stermac, Del Bove, & Addison, 2001; Stermac, Del Bove, Brazeau, & Bainbridge, 2006). Based on this approach, weights are assigned in ascending order for the following findings: tenderness; pain; contusions; fractures; and internal injuries. Each injury is multiplied by its corresponding weight and the total score is considered to be an index of the severity of injury. The score does not include some types of injury (e.g. penetrating injury) and mixes subjective symptoms (e.g. pain) with objective findings but is considered a significant improvement over the "number of injuries" approach. To date this index has only been used with an outcome of physical injury but could be easily adapted for use with genital and nongenital injury.

Populations and Settings

The setting and method of data collection may have an impact on injury rates or on the effects of various risk factors. For example, a group of Canadian women were found to be 3.5 times more likely to report to police if injuries were present (Du Mont, Miller, & Myhr, 2003). Injury rates may differ when data are obtained from women's self-reports in surveys compared to rates from clinical examinations. Memory may have an impact on numbers of injuries if time has elapsed. Only a third of women with injuries from sexual assault were found to have pain or bleeding, and their injuries would have been missed without a physical examination (Rambow, Adkinson, Frost, & Peterson, 1992).

Examiner Experience and Techniques

The expertise of the examiner with sexual assault examinations and the techniques used to visualize the examination are associated with variations in injury rates. Dedicated teams of sexual assault nurse examiners (SANEs) have emerged in the last decade in Canada, based on the success of similar teams in the United States. SANEs have relatively standardized education and clinical practica related to care of sexually assaulted clients. Although there are differences in the number and type of injuries they assess and document, the rates of injury are generally higher when SANEs conduct the examination (Sommers et al., 2001), compared to Emergency physicians. This may be due to experience in detecting the more subtle injuries associated with sexual assault. SANEs are also more likely than other groups of examiners to use visualization adjuncts. The effects of different examiners and techniques warrants further investigation.

Limited Canadian Research

Lastly, there are a number of significant Canadian studies on sexual assault injuries. The majority of the research is from the United States. Availability of free health care, gun control legislation, and broader definitions of sexual assault in Canada limit the ability to generalize American studies to the Canadian context. Differences in population distribution and racial groups may also influence injuries.

Purpose of the Research

A number of factors appear to affect the rates of injuries and the effects of reported risk factors for injury following sexual assault. The resulting differences highlight the need to examine relationships between risk factors and injury further. The purpose of this research was to improve understanding of the rates of injuries and risk factors for injury among women who have been recently sexually assaulted. This is required before nurses can begin to develop and test effective injury prevention or intervention strategies or look at injury in relation to other consequences such as PTSD. The following questions need to be addressed regarding injuries in women after recent sexual assault:

1. What is the quality of existing evidence related to injury outcomes and risk factors for injury?
2. What are the rates and severity of injuries?
3. What factors affect variability of injury rates?
4. What biographic, contextual and assault risk factors have been studied?
5. What are the influences of risk factors on each other and on injury outcomes?

These questions are addressed through two separate studies. First, a systematic review of the literature was conducted using the existing literature on injuries and risks for injury in women after sexual assault. The results of the review were then combined with observations from clinical settings and descriptive literature to develop and test a theoretical model of the influence of risk factors on the severity of genital and nongenital injury using a group of Canadian women seeking postassault care from SANEs in one urban centre. A study conducted in a Canadian region with a standardized approach and SANEs was thought to have the best possible capacity to consistently assess injuries and document the related risk factors.

Organization of the Dissertation

A paper format was selected for the dissertation, using the University of Alberta guidelines (Faculty of Graduate Studies & Research, 2006). There are four chapters in the dissertation, each with a separate reference list. The introduction and context for the research has been provided in this chapter (Chapter 1). The results of the systematic review of injuries and risk factors for injury in women after sexual assault are in Chapter 2. Chapter 3 describes the development and testing of the theoretical model of how risk factors relate to each other and contribute to genital, nongenital injury or both. Each study is presented as a separate manuscript and written in the style of the journal to which it will eventually be submitted. The final chapter (Chapter 4) contains a discussion of the results and future directions for practice, education and research.

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CHAPTER 2: SYSTEMATIC REVIEW OF WOMEN'S RISKS FOR INJURY FROM SEXUAL ASSAULT

Approximately 39% of Canadian women have experienced a sexual assault.[1] These millions of women face both immediate and long term physical, psychological and legal consequences related to the presence of injuries.

The presence of injuries has physical, psychological and legal consequences. The presence of injuries increases the risk that women will acquire sexually transmitted diseases such as HIV if exposed.[2] Injuries have also been linked to increased risks of developing posttraumatic stress disorder (PTSD),[3] which is generally more severe and difficult to treat in women than men.[4] Furthermore, PTSD is associated with the development of major depression, anxiety disorders, substance use and somatic symptoms.[5]

There is also a legal significance to the presence of injuries. It is expected that after a "real rape" the woman will have injuries.[6] Police and judges have been found more likely to believe that a sexual assault has occurred if injuries are present.[7] Canadian police are obliged to have a reasonable degree of certainty that the case will be successful before they can lay charges and send the case proceeds to the crown prosecutor.[8] In a Canadian study it was found that charges were more likely to be laid if physical injuries were present.[9] If the woman's case does proceed to court, then health professionals are asked to testify in court regarding the presence, significance and even legitimacy of injuries in the case. Unfortunately, despite the significance of injuries to women, relatively little is known about how often women are injured, what types of injuries they sustain or the types of risk factors most often associated with injury.

Literature Review

A preliminary review of the literature revealed many inconsistencies in the injury research. If the injury was defined as "physical injury" (no site specified), rates ranged from 27% [10] to 90%.[11] Rates for "genital" injuries ranged from 12% [12] to 83%.[13] "Nongenital" injury rates ranged from 33% [13] to 82%.[14] Researchers predominantly reported the rate or proportion of injury, although some reported the numbers of injury types or sites, and sometimes severity of injury was reported. Not all researchers considered redness, swelling or tenderness as injuries, affecting rates of injury.

The injury rates have been reported to vary depending on the type of professional conducting the examination,[15] their experience with sexual assault examinations,[16] and their use of adjuncts to view genital injuries such as toluidine dye [17,18] or colposcopy with magnification.[18] The variability in injury rates may also be influenced by the time between the assault and the examination. If women are seen within less than 72 hours their genital injuries are more likely to be seen and many of their nongenital injuries will also be visible. Genital injuries generally heal within 48 to 72 hours due to the vascularity of the region.[19] If women present within less than 24 hours some of their nongenital injuries may not yet be seen as deep bruising may also take as long as 24 hours to appear. These factors all varied across the research and sometimes were not described.

The population and setting varied across the studies and may be possible sources of variation in injury rates. Populations included men and women, adults and children, those reporting to health care agencies or sexual assault clinics and those reporting to police. It is estimated that less than a third of women seek health care after a sexual assault and even less report to police.[20,21] It is not clear, however, if the severity or rates of injuries differ in settings where women are given the option of reporting to police compared to settings in which reporting is mandatory (e.g police sponsored clinics).

The source of the data varied across studies. Some studies used survey data in which respondents self-reported their injuries rather than clinic data. The number or rates of injuries may be underestimated in self-reports as the majority of women do not experience pain or bleeding with injuries after recent sexual assault.[22]

The types of risk factors selected for study, their definitions and the effects of the risk factors varied across the research. Even when similar definitions of risk factor were present, the level of measurement of the data often differed, making comparisons difficult. Some reported rates, while others reported odds ratios or coefficients. The effects of the risk factors varied perhaps due to the type of outcome measure. As an example, adolescence was a significant risk factor for "physical injury" among women seen at clinics [23] but not significant when data came from police files [24] or when "nongenital injury" was the outcome.[25-27]

The complexity of risk factors and outcomes suggests interrelationships between the risk factors, although relationships have only been studied in a limited number of multivariate studies. The outcomes differed, the risk factors included differed, and study results were not all in agreement. Some researchers described selecting risk factors for the multivariate analysis only if the factor was significant in preceding univariate analyses. This method ignores the theoretical underpinnings of the type of injury and thus may result in an incomplete explanation of the risk factors leading to injury. In addition, it may also lead to the omission of a risk factor that might be significant if interactions with another factors or injury outcome were considered.

In summary, the rates of injury and effects of various risk factors for injury are not clear in the current literature. Injury outcomes may be influenced by the type of injury studied, the types of risk factors studied, the level of measurement, the population or setting, and the type of analyses used. Given the physical, psychological, and legal consequences of injury associated with sexual assault, a better understanding of rates of injury and risk factors for injury is required in order to identify those likely to have injury, to prevent further illness or injury and to support legal decisions and opinions.

Purpose of the Study

The purpose of this study was to conduct a systematic review of the literature pertaining to injury outcomes after recent sexual assault. Attempts to summarize the literature descriptively do not necessarily include all of the relevant literature and may lead to inconsistent results or interpretations.[28] In contrast, systematic reviews require more rigour in the literature review process regardless of whether they are narrative or meta-analytic in nature. Both forms of systematic review require the reviewer to leave an audit trail of included and excluded studies for reproducibility. Meta-analytic techniques allow pooling of samples and aggregation of data to help determine the influence of a particular variable.

The injury outcomes of interest include nongenital, genital, and physical injury. The presence of sexual assault training or use of experienced examiners, and the use of visualization adjuncts were included in the description of the results for each risk factor in light of its potential to affect the rate of injuries reported. Questions for the review included the following:

1. What is the quality of existing evidence related to injury outcomes and risk factors for injury?
2. What are the rates and severity of injuries (genital, nongenital, or physical)?
3. What factors affect variability of injury rates?
4. What influences do biographic, contextual and assault risk factors from the literature have on injury outcomes?

Methods

Search Strategy

The search strategy was determined prospectively and included multiple approaches. Restricting a search to computer databases has been found to yield only half of all relevant studies [29]. The electronic search included four main sources: Medline (1966 to December 2006), CINAHL on OVID (1982 to December 2006), CINAHL from EBSCOhost (1982 to December 2006), and EMBASE (1988 to December 2006). Search terms included:

1. (explode sex offenses or explode rape or (sexual$ adj2 assault$) or rape AND (explode wounds and injuries)
2. sexual assault or rape
3. injury or injuries
4. 2 and 3
5. 2 not 3

These terms were used for all four databases. There were no restrictions on the language initially. If a foreign language abstract was available in English it was considered if sufficient data were in the abstract to meet inclusion criteria. If not, only

English and French articles were used, as both were spoken by the primary reviewer. An additional search was then conducted using Google, with search terms of "sexual assault OR rape" AND "injury OR trauma". Two additional databases were searched for theses and dissertations: Theses Canada Portal; and Electronic Dissertations and Theses (EDT).

Additional search strategies used included the invisible college approach and the ancestry approach.[30] The invisible college approach consisted of contacting colleagues in sexual assault nursing through email, an online list-serve and personal contacts at scientific assemblies to identify potential unpublished studies related to sexual assault injuries. An additional step was to review abstracts from the preceding four years of forensic nursing conference proceedings of the International Association of Forensic Nurses Scientific Assembly. These years were selected because most of the nursing research on injuries has emerged in that time period. The ancestry approach [30] included checking reference lists of relevant studies to uncover publications not identified in the computer search.

A hand search was then conducted of the indexes of key journals. The search covered publications issued between January 2002 and December 2006, as the bulk of the sexual assault injury research has occurred mainly in these more recent years. Journals were selected for hand searches if they had at least 5 publications that were potentially relevant. The following journals were selected: *Journal of Forensic Science*; *American Journal of Obstetrics & Gynecology*; *Forensic Science International*; *Journal of Clinical Forensic Medicine*; *Journal of Emergency Nursing; Annals of Emergency Medicine*; *JAMA*; and *Violence and Victims*. An additional two journals were searched, as they are directly relevant to the research area and the discipline of forensic nursing: *On the Edge*;

and *Journal of Forensic Nursing*. The *Journal of Forensic Nursing* commenced in March 2005, therefore only one and a half years of journals were available for the search.

Selection of Risk Factors and Outcomes

A preliminary set of risk factors and injury outcomes was required to guide the systematic review. It was recognized that the definitions for these would be driven by the studies and that terminology or categories within the risk factor may change during the review. Risk factors and outcomes for the set were derived from eight multivariate injury studies available at the time of the initial review. Injury outcomes in these multivariate studies included presence of "physical injury" anywhere on the body,[24,31] both "genital" and "nongenital" injuries,[25,27,32,33] or only "genital" injuries.[34,35] The risk factors included in these studies are summarized in Table 2-1. The risk factors were grouped into biographic factors, contextual factors, or assault risk factors. These categories and factors were used at the beginning of the review, with additional risk factors added as identified.

Table 2-1

Risk Factors and Outcomes Used in Multivariate Studies

Biographic Factors *	**Contextual Factors***	**Assault Factors***	**Outcomes***
Woman's age (6) Race (3) Unconscious (3) Alcohol/drug use (3) Prior sexual experience (2) Education (1) Marital status (1) Income (1) Psychiatric diagnosis (1)	Assailant relationship (8) Assault setting (5) Amnesia for attack (2) Day of week (1) City/region (1) Confidence vs. blitz (1)	Weapon (5) Site of penetration (5) Multiple assailants (4) Force (4) Penetration object (3) Restraints (2) Strangulation (2) Threats(2) Victim resistance (2)	Genital injuries (4) Nongenital injuries (4) Presence of both genital & nongenital injuries (3) Physical injury (2)

( ) number of studies citing this risk factor (total studies=8)

Inclusion Criteria

Research studies were included in the review if they met all of the following criteria: recent sexual assault (e.g. within last week); an injury outcome was reported (genital, nongenital or physical injury); at least one risk factor (biographic, contextual, or assault) was studied in relation to injury outcomes; all subjects were female and of at least menarchal age (e.g. 10 years or more); and data were obtained from clinical reports or files rather than from women's self-report of physical injury.

Definitions

"Sexual assault" is defined as any undesired contact of a sexual nature, consistent with Canadian Criminal Code definitions. The Canadian Criminal Code was amended to include the crime of sexual assault rather than rape or indecent assault in 1983.[36] The term "rape" referred only to penetration of the vagina with a penis or foreign body, thus excluding many other sexual acts. The crime of sexual assault now includes a broader variety of acts, both in Canadian [37] and in American definitions [38] and encompasses acts such as sexual abuse, sexual assault within the context of intimate partner violence and stranger assaults.

All injury outcomes were included in the review: physical injury; genital injury; or nongenital injury. The term "physical" injury was used for those studies in which researchers indicated presence of injury but did not specify the location (e.g. genital or nongenital). "Genital" injuries included those to the vaginal, perineal, and peri-anal regions, and have also been known as "ano-genital" injuries. "Nongenital" injury, sometimes referred to as body trauma or physical trauma, included injury to any area other than the genital or anal regions. Data for genital and nongenital injuries were included both as frequency outcomes (number of women injured) or as continuous measures (numbers of sites of injuries).

Risk factors of interest were grouped into biographic, contextual, or assault variables as they were for the multivariate risk factor review. Biographic risk factors included anything about the individual prior to the assault that may have contributed to risk of injury or severity. These included indicators of physical maturity (e.g. age, prior sexual experience), sociocultural factors (race, income), vulnerability (psychiatric disorders or disabilities); and impaired consciousness (altered level of consciousness, substance use). Contextual factors included any factor in the environment or relationship that may influence injury (e.g. intimate relationship with the assailant, privacy of the assault setting). Assault variables related to factors that directly injure (e.g. physical aggression, weapons, site of penetration, objects of penetration, lubrication, physical resistance), increase violence (e.g. physical or verbal resistance), or that may affect intimidation of the victim (e.g. verbal aggression, multiple assailants).

Interrater Reliability

One reviewer conducted the primary review of the literature. A second reviewer was used to verify the selection of all included studies and to assess interrater reliability of the data abstraction on a subset of the included studies. Both reviewers were sexual assault nurse examiners, and were familiar with research methods and the sexual assault literature. Articles were selected based on the study inclusion criteria. The two reviewers independently reviewed all citation titles for potential eligibility and inclusion. The results of the reviewers' decisions to include or exclude were tested for interrater reliability using a kappa statistic. A satisfactory level of agreement was set apriori as "fair" if the kappa was between 0.4 and 0.75 and "excellent" if greater than 0.75.[39] In instances of disagreement on the article selection, the two researchers met after the reviews to discuss reasons for disagreement and to reach consensus for inclusion.

Data abstraction was conducted using a form developed for the review. This form was pre-tested with a set of eight studies considered to be representative of the types of studies desired for the review. Minor revisions were made throughout the study to include new risk factors identified in the studies. New factors included lubrication, digital penetration and time of day of the assault. Modifications of risk factors included the addition of mutually exclusive subsets of genital and nongenital injury outcomes that emerged in the studies. Once data abstraction was complete, a second reviewer was given a randomly selected sample of 10% of the included articles and their data abstraction forms. The second reviewer then verified the accuracy of the data.

Study Assessment

Assessment of the quality of studies is used to measure the extent to which studies are protected against bias and inferential error.[40] The MINORS scale [41] was selected for this study a priori as it was designed and tested for use in systematic reviews with nonrandomized studies. It was anticipated that the majority of the studies would be nonrandomized designs. The scale has demonstrated good-to-excellent kappa statistics: 0.66 high interrater agreement (0.56-0.87 for all items), test-retest kappa statistics between 0.59 and 1.0, and external validity as demonstrated by a mean score of 23.1 out of 24 on the 15 "gold standard" studies. There are two parts to the MINORS: a series of questions for non-comparative studies; and additional questions for comparative studies. There are eight items in the non-comparative section, each scored from 0 (not reported or applicable) to 2 (reported and adequate). The items include: a clearly stated aim;

inclusion of consecutive patients; prospective data collection protocol; endpoints appropriate to the aim of the study; unbiased assessment of study endpoints; appropriate follow up period; loss to follow up of less than 5%; and prospective calculation of study size. All included studies were non-comparative, therefore the comparative items were not used.

During the initial phases of the systematic review the MINORS Scale did not appear to vary appreciably between studies or consistently reflect the studies thought to be most relevant or high quality by the primary reviewer. The areas not reflected in the scale related mainly to procedures or aspects of the setting specific to care of sexual assault patients. The set of items were referred to as the Sexual Assault Study Quality (SASQ). Items included the following information and assigned points:

a) participants. The population setting and demographics were adequately reported to allow comparison (2), there were some gaps (1) or it was not described (0). The age group was all the same age group such as adolescent, adult or elderly (2), contained two age groups (1) or was a mix of all three (0).

b) settings. The setting allowed women to report to police as an option (2) rather than a mandatory element such as a police unit (1) or was not described (0).

c) outcomes. The injuries with the risk factors were described in a format that could be used for the study such as rates, numbers or means (2), rather than odds ratios or coefficients (1) or not at all (0). The time to treatment was less than 72 hours for at least 75% of women (2), for more than 50% of the women (1) or for less than 50% of the women (0). The examiner was a SANE or sexual assault physician (2) versus Emergency physician or someone with limited experience in sexual assault examinations (1) or was not described (0).

d) *treatments*. The adjuncts used to visualize injuries included toluidine blue dye and colposcopy with magnification (2), either adjunct (1), or was not described or used (0).

The maximum score for each item was 2 points for a total possible score of 14 points. The final score on the SASQ was converted to a percentage to allow comparison with the MINORS percentage.

Data Extraction

All study results were entered into an Excel spreadsheet initially, to allow examination of study heterogeneity and characteristics. If subgroups or strata were reported within a study and injury data were available for the subgroup, each group was reported as a separate cohort for analysis. The following data were extracted for analysis: author and publication information; study design; population and setting; quality and design items; overall injury outcomes (rates, mean numbers, severity); and injury outcomes for any risk factors reported.

All injury outcomes were extracted and recorded in their original scales and formats for each study. Once data abstraction was complete the categories were examined across the studies for similarities. Study categories were then modified if there were similar groupings and definitions in the studies. An example is the adolescent category. This age group was consistently described across studies as beginning at 14 to 15 and ending at 19 to 20 years of age so an adolescent category was created to include any females within these age ranges.

Data Analysis

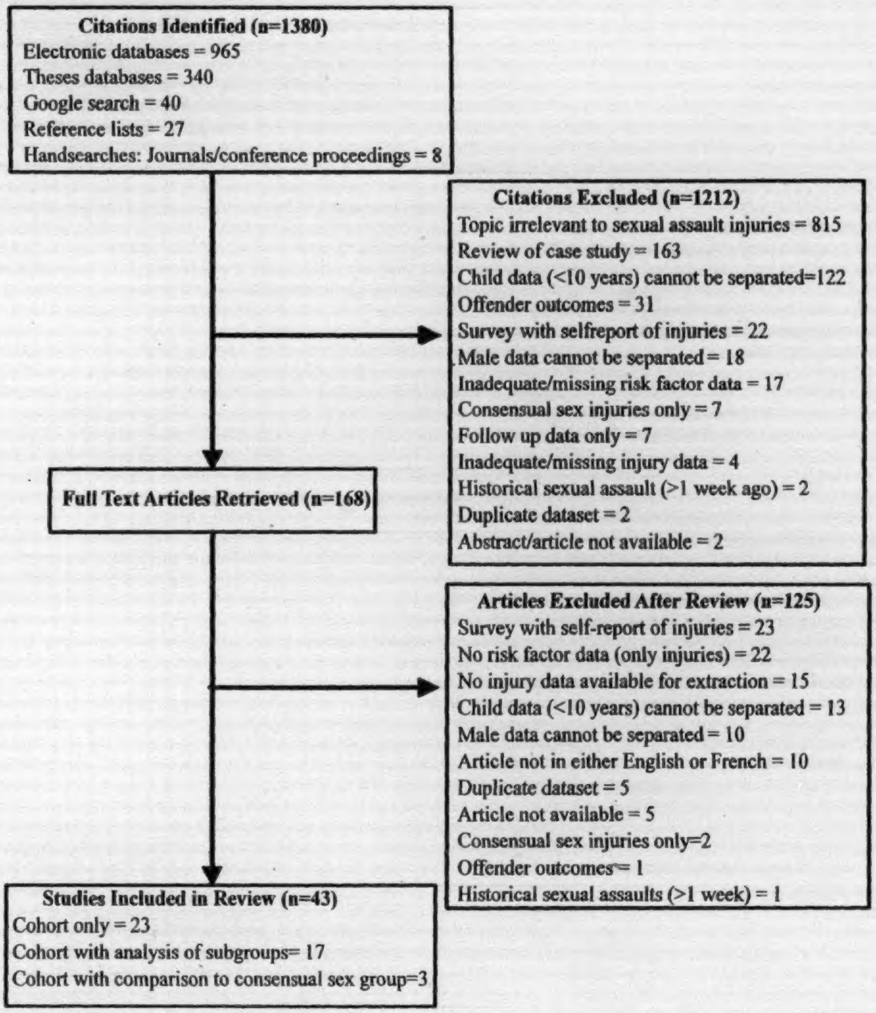
Study results were analyzed primarily using Stata version 9.[42] The studies were anticipated to be mainly cohort designs, which would limit analyses primarily to narrative comparisons. Summary estimates were determined for risks and injuries, focusing on the median percentage of women injured with that risk factor present, the sample size and the range of proportions. If there were 30 or more studies in a particular grouping, then interquartile ranges were also presented in order to limit the influence of outliers often found in larger datasets.

In instances where there were both within study and between study data available, meta-analyses were conducted. Forest plots were generated, along with relative risks for each within study comparison. Relative risk was selected as the appropriate risk estimate for cohort studies.[43] A random effects method was used for the calculations as it was assumed that there would be significant heterogeneity across the studies. Heterogeneity was explored across the studies used in the meta-analyses using the I^2 statistic. The I^2 provides the percentage of variation across studies that is due to heterogeneity rather than chance.[44] An I^2 of 50% has been described as moderate heterogeneity and values greater than 75% as high.[44] Thus, in this study, if the I^2 was greater than75%, the relative risks were not pooled across studies. If the I^2 was equal to or less than 75%, results were pooled across studies.

Results

The search included all available articles identifiable prior to the end of December 2006. The results of the search are summarized in Figure 2-1.

Figure 2-1. Flow Chart


Citations Identified (n=1380)
Electronic databases = 965
Theses databases = 340
Google search = 40
Reference lists = 27
Handsearches: Journals/conference proceedings = 8
Citations Excluded (n=1212)
Topic irrelevant to sexual assault injuries = 815
Review of case study = 163
Child data (<10 years) cannot be separated=122
Offender outcomes = 31
Survey with selfreport of injuries = 22
Male data cannot be separated = 18
Inadequate/missing risk factor data = 17
Consensual sex injuries only = 7
Follow up data only = 7
Inadequate/missing injury data = 4
Historical sexual assault (>1 week ago) = 2
Duplicate dataset = 2
Abstract/article not available = 2
Full Text Articles Retrieved (n=168)
Articles Excluded After Review (n=125)
Survey with self-report of injuries = 23
No risk factor data (only injuries) = 22
No injury data available for extraction = 15
Child data (<10 years) cannot be separated = 13
Male data cannot be separated = 10
Article not in either English or French = 10
Duplicate dataset = 5
Article not available = 5
Consensual sex injuries only=2
Offender outcomes= 1
Historical sexual assaults (>1 week) = 1
Studies Included in Review (n=43)
Cohort only = 23
Cohort with analysis of subgroups= 17
Cohort with comparison to consensual sex group=3

There were 1380 citations identified, but only 168 met the criteria for review of the full article. Two French articles were translated by the primary reviewer but did not meet the criteria for inclusion.[45,46] The remaining 10 foreign language articles were excluded as the abstracts were insufficient to extract data and translation was not available. In addition, it was decided that there may be cultural or regional issues in sexual assault or sexual assault examinations that may affect the internal or external validity of the studies.

There were another 5 articles which were unavailable. Only 43 of the remaining 153 articles met the inclusion criteria after the articles were reviewed.

Interrater Reliability

Two reviewers rated all 153 remaining articles for potential inclusion. The interrater agreement between the two raters was 96.7%. The kappa statistic was 0.92 with a standard error of 0.08 (p=0.0000). This kappa is considered a substantial level of agreement.[47,48] There were 5 articles for which reviewers disagreed. Two were initially excluded by the second reviewer due to questions regarding the age criterion, but were included after discussion between reviewers. A third was excluded by the second reviewer as it was thought there would be insufficient risk data. All three studies were retained after discussion. An additional two studies were excluded by the primary reviewer but had been included by the second reviewer. After discussion it was agreed to leave these two out, as one was a report of a portion of data already reported in another study. The other study had injury data but did not report the injuries in relation to risk factors. The final sample included 43 articles for which both reviewers agreed.

A sample of 5 of the data forms (approximately 10%) was provided for the second rater to review accuracy with the original articles. There were no errors or omissions detected in the data extracted from each study.

Included Study Characteristics

All studies included in this analysis used a cohort design. The characteristics of the included studies are shown in Table 2-2. In 17 of the studies, researchers analyzed subgroups of the cohort based on presence or absence of various risk factors for injury (e.g. relationship to the victim, age, prior sexual experience). The majority of the studies were from the USA and involved settings in which police reporting was optional. In addition to the main cohort group, in three of the studies the researchers obtained a comparison group of women (mainly prospectively) who had experienced recent consensual intercourse. The consensual cohorts were not used in the review.

Table 2-2

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examiner[a] (adjunct)[b]*	*Police report[c]*
Anderson	2006	USA	Comparison A-assault cohort B-consensual sex group	56 46	26.3(10.3) 29.3 (6.0)	1=genital injury 2=effect of consent on injury	SANE (TD& CM)	Opt
Sommers	2006	USA	Subgroups (age): A-50 yrs + B: 40-49 yrs C: <40 yrs	40 40 40	46.3 (23.8)	1=number and type of genital injuries	SANE	Opt
Stermac	2006	Canada	Subgroups (relationship): A- stranger B-known>24 hrs C intimate	342 326 336	28.6 (2.1) 25.9 (9.9) 27.5 (10.4)	1=coercion, violence, genital and nongenital injury	SANE	Opt
White	2006	UK	Subgroups (prior sex): A-no prior sex B-prior sex	81 97	[12-17]	1=rate of genital injury	SAMD	Mand
Crane	2005	USA	Subgroups (3 different settings): A-urban & rural B-coastal urban C-south urban	620 1096 1602	26.6(11.1) 27.5(11.1) 26.9(10.9)	1=genital and nongenital injury 2=correlate of injury	SANE	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police

Table 2-2 (cont'd)

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examiner*[a] *(adjunct)*[b]	*Police report*[c]
Del Bove	2005	Canada	Subgroups (age): A: 15 to 29 yrs B: 30 to 55 yrs C: > 55 yrs	61 73 78	21.8(4.5) 37.9 (6.1) 64.6 (9.2)	1=physical injury 2=effects of coercion, age	SAMD	Opt
Hilden	2005	Denmark	Neither	249	[12-60]	1=genital injury 2=correlate of injury	MD	Mand
Read	2005	USA	Neither	831	25 [13-85]	1=victim characteristics, genital & nongenital injury	SANE (TD, CM)	Mand
Jones	2004	USA	Subgroups (relationship): A-Stranger B-Known	238 611	A=25.6 (11.0) B=21.3 (9.8)	1=differences in genital or body injury, violence, coercion between groups	SANE (TD, CM)	Opt
Palmer	2004	Australia	Neither	153	[14-73] median 23 yrs	1=genital and nongenital injury 2=risk factors for injury	SAMD	Mand
Rossman	2004	USA	Neither	53	20.4 (8.3)	1=genital injuries if digital penetration	SANE	Opt
Sugar	2004	USA	Neither	819	29.3 (11.7)	1=correlates of genital and nongenital injury	MD	Opt
DuMont	2003	Canada	Neither	186	27.0 (9.3)	1=police reporting 2=physical injury & force	SAMD, SANE	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police.

Table 2-2 (cont'd)

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examiner[a] (adjunct)[b]*	*Police report[c]*
Eckert	2002	USA	Neither	819	32.8(10.3)	1=risk for sexual assault if psychiatric diagnosis 2=risk for injury	MD (CN)	Opt
Jones	2003	USA	Comparison: A- assaulted cohort B-consensual sex group	204 51	15.1 (1.6)	1=genital injury 2=effect of consent on injury	SANE	Opt
Millar	2002	Canada	Subgroups (hours since assault)	1118	26.9 (10.3)	1= treatment seeking correlates (including genital injury)	SAMD	Opt
Sachs	2002	USA	Neither	209	[15-50]	1=genital injury & assault characteristics	SANE (TD, CM)	Mand
Adams	2001	USA	Neither	214	16.3 [14-19]	1=genital injury 2=injury correlates	SANE (TD & CM)	Mand
Stermac	2001	Canada	Subgroups (relationship): A-spouse B-boyfriend C-acquaintance	97 256 194	31.7 (9.3) 26.3 (7.9) 25.5 (10.3)	1=coercion & violence, injuries, trauma severity, service delivery	SANE	Opt
Rossman	2000	USA	Subgroups (prior sex): A-no prior sex B-prior sex	82 328	17 26	1=genital injury	SANE SANE	Opt
Ullman	1999	USA	Subgroups (# assailants) from 2 samples (A – founded rapes) (B- any rape complaint)	1269 550	25.6 (9.6) 25.9 (10.1)	1=sexual acts, violence, physical injuries	missing	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police

Table 2-2 (cont'd)

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examiner[a] (adjunct)[b]*	*Police report[c]*
Biggs	1998	Canada	Subgroups (prior sex): A-no prior sex B-prior sex	66 66	21.6[15-64] 20.8[15-56]	1=genital injuries 2=effect of prior sex on injuries	SAMD	Opt
Emmert	1998	Germany	Neither	97	[11-18]	1=genital & nongenital injury, assault, victim/ offender characteristics	SAMD	Opt
Lenehan	1998	USA	Neither	17	[15 +]	1=sensitiveity of colposcope to detect injury 2=genital & body injury	SANE (CM)	Opt
Bowyer	1997	New Zealand	Neither	83	25.3 [16-48]	1=genital & nongenital injury	SAMD	Opt
Slaughter	1997	USA	Comparison: A-assault cohort B-consensual cohort	311 75	[11-85]	1=types & locations of genital injury	SANE	Mand
Muram	1995	USA	Subgroup (age): A-adolescent 13-18 yrs B-adults 25-44 yrs	176 197	15.2(1.6) 31.9(5.1)	1=risk factors for assault 2=consequences (e.g.-injury)	SANE	Opt
Stermac	1995	Canada	Subgroups (relationship): A-stranger assailants B-known assailants	220 455	26.5 [14-87]	1=violence, coercion, injury	SAMD	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police

Table 2-2 (cont'd)

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examiner[a] (adjunct)[b]*	*Police report[c]*
Ramin	1992	USA	Subgroup (age) A: > 49 yrs (all eligible) B: 14-49 yrs (random)	129 129	64 (1.0)	1=genital & nongenital injury, victim characteristics	MD	Opt
Bownes	1991	Ireland	Subgroups (assailant relationship): A-stranger B-known	30 21	21.8 (8.8)	1=context, assault characteristic, injury, postassault behaviour	SAMD	Mand
Satin	1991	USA	Subgroups (pregnancy pre-assault): A-pregnant B-nonpregnant	114 114	21.7 (4.9) 22.1(4.9)	1=victim characteristic, injury patterns & evidence	MD	Opt
Penttila	1990	Finland	Neither	249	[<14-50+]	1=assault & victim characteristics, injuries, legal outcome	SAMD	Mand
Cartwright	1989	USA	Neither	21	[60-90]	1=genital & nongenital injuries	MD	Opt
Goodyear-Smith	1989	Australia	Neither	81	[15-83]	1=assault, victim/offender characteristics, genital & nongenital injury	SAMD	Opt
Rodenas	1989	Spain	Neither	86	19.2 (7.2)	1=victim & assault characteristics & body injury	missing	Mand
Ruback	1988	USA	Neither	182	[16+]	1=physical injury & resistance	SANE	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police

Table 2-2 (cont'd)

Included Study Characteristics

Author (year)	*Year*	*Country*	*Subgroup Analyses (type) or comparisons*	*# Cases*	*Mean age (SD) [range]*	*Outcomes 1=primary 2=secondary*	*Examin-er[a] (adjunct)[b]*	*Police report[c]*
Cartwright	1987	USA	Neither	405	[10-50+]	1=genital injury	MD	Opt
Cartwright	1986	USA	Neither	440	[21+]	1=genital injury	MD	Opt
Tintinalli	1985	USA	Neither	372	25 [13-78]	1=patterns of genital and nongenital injury, victim characteristics	SAMD	Mand
Schiff	1979	USA	Neither	100	29.5 [10-85]	1=victim & assault characteristic, virginity, injury	MD	Opt

[a] Examiners: MD=Emergency or Gynecology physicians (or residents); SAMD= sexual assault physician; SANE=sexual assault nurse examiners; [b] Adjuncts used to visualize injuries: CN=colposcopy without magnification; CM=colposcopy with magnification; TD=toluidine dye; CT=toluidine & colposcopy with magnification; blank=not stated; [c] Police: Mand=police reported assaults only in cohort; Opt = optional for patients to report to police

Study Quality

Study quality was assessed using the MINORS scale and the SASQ. The scores on the MINORS scale are shown in Table 2-3. The studies were all non-comparative retrospective cohort designs therefore the comparative items on the scale were not used. Two items within the non-comparative items were not relevant to any of the studies (appropriateness of the follow-up period for the study; and the loss to follow-up during the study) due to the retrospective cohort design and were not included in the calculations Thus, the possible maximum MINORS score was 12, with studies receiving up to 2 points for each item.

Table 2-3

MINORS Scale Ratings

Author	Year	Aim Clearly Stated	Consecutive patients entered	Prospective Protocol	Outcome(s) clearly stated	Endpoints Blindly Assessed	Sample size calculations apriori	Score (%)
Anderson	(2006)	2	1	1	2	0	0	50
Sommers	(2006)	2	2	2	2	0	0	67
Stermac	(2006)	2	2	2	2	0	1	75
White	(2006)	2	2	2	1	0	0	58
Crane	(2005)	2	2	2	2	0	0	67
Del Bove	(2005)	2	1	2	2	0	0	58
Hilden	(2005)	2	0	2	1	0	0	42
Read	(2005)	2	2	2	2	0	0	67
Jones	(2004)	2	2	2	2	0	0	67
Palmer	(2004)	2	2	2	1	0	0	58
Rossman	(2004)	2	2	2	1	0	0	58
Sugar	(2004)	2	2	2	2	0	0	67
Du Mont	(2003)	2	2	2	1	0	0	58
Jones	(2003)	2	2	2	2	2	0	83
Jones	(2003b)	2	2	2	2	0	0	67
Schei	(2003)	2	2	2	1	0	0	58
Eckert	(2002)	2	2	2	2	2	0	83
Millar	(2002)	2	2	2	1	0	0	58
Sachs	(2002)	2	0	2	2	2	0	67
Adams	(2001)	2	2	2	2	0	0	67
Stermac	(2001)	2	2	2	2	0	0	67
Rossman	(2000)	1	1	2	1	0	0	42
Ullman Group A	(1999)	2	1	2	2	0	0	58
Ullman Group B	(1999)	2	2	2	2	0	0	67
Biggs	(1998)	2	2	2	2	0	0	67
Emmert	(1998)	2	0	1	1	0	0	33
Lenehan	(1998)	2	2	2	2	0	0	67
Bowyer	(1997)	2	1	2	0	0	0	42
Slaughter	(1997)	2	1	2	1	0	0	50
Muram	(1995)	2	2	2	1	0	0	58
Stermac	(1995)	2	2	2	1	0	0	58
Ramin	(1992)	2	2	2	1	0	2	75
Bownes	(1991)	2	2	2	0	0	0	50
Satin	(1991)	2	2	2	2	0	0	67
Penttila	(1990)	2	2	2	1	0	0	58
Cartwright	(1989)	2	2	2	1	0	0	58
Goodyear-Smith	(1989)	2	2	2	2	0	0	67
Rodenas	(1989)	2	2	2	1	0	0	58
Cartwright	(1987)	2	2	2	1	0	0	58
Cartwright	(1986)	2	2	2	1	0	0	58
Olusanya	(1986)	1	2	2	1	0	0	50
Tintinalli	(1985)	2	2	2	2	0	0	67
Schiff	(1979)	2	1	2	2	0	0	58

0=not reported/not done 1=reported but inadequate or some gaps 2=reported and adequate

The total of the scores for all studies using the SASQ are shown in Table 2-4. There was more variability between SASQ scores than between MINORS scale scores, but the scores were significantly correlated (r=.30, p=0.05). It was anticipated that the MINORS scores and SASQ would be related as they are both measures of study quality but only a weak correlation was expected. This is because the items in the list were specific to this review, are not intended to be comprehensive representations of all concepts, and the items have not been validated for use outside this review.

Table 2-4

SASQ Scores

Author	Year	Description of sample	Age mix	Sampling bias	<72 hrs post assault	Examiner forensic skill	Adjuncts	Risk Data	Score (%)
Anderson	(2006)	2	0	1	2	2	2	2	79
Sommers	(2006)	2	0	2	2	2	0	2	71
Stermac	(2006)	2	0	2	2	2	0	1	64
White	(2006)	2	2	1	1	2	0	2	71
Crane	(2005)	1	0	2	2	2	0	1	57
Del Bove	(2005)	2	1	2	2	2	0	1	71
Hilden	(2005)	1	0	1	2	1	0	2	50
Read	(2005)	1	0	1	0	2	2	1	50
Jones	(2004)	2	1	2	1	2	0	1	64
Palmer	(2004)	1	0	1	2	2	0	0	43
Rossman	(2004)	1	1	0	0	2	0	1	36
Sugar	(2004)	1	0	2	2	1	0	2	57
Du Mont	(2003)	1	0	2	2	2	0	1	57
Jones	(2003)	1	2	2	1	2	2	1	79
Jones	(2003b)	2	1	2	2	2	2	2	94
Schei	(2003)	2	1	2	2	2	0	2	79
Eckert	(2002)	1	1	2	2	1	0	2	64
Millar	(2002)	1	0	2	1	0	0	2	43
Sachs	(2002)	1	1	1	1	2	2	1	64
Adams	(2001)	2	2	1	2	2	2	2	93
Stermac	(2001)	1	0	2	2	2	0	1	57
Rossman	(2000)	1	1	1	0	2	1	2	57
Ullman Group A	(1999)	2	1	1	0	0	0	0	29
Ullman Group B	(1999)	1	1	2	0	0	0	0	29
Biggs	(1998)	2	0	2	0	2	0	2	57
Emmert	(1998)	0	2	1	0	2	0	0	36
Lenehan	(1998)	2	0	2	2	2	1	2	79
Bowyer	(1997)	1	1	2	0	2	0	2	57
Slaughter	(1997)	1	1	1	2	2	0	2	64

Table 2-4 (cont'd)

SASQ Scores

Author	Year	Description of sample	Age mix	Sampling bias	<72 hrs post assault	Examiner forensic skill	Adjuncts	Risk Data	Score (%)
Muram	(1995)	1	0	2	2	2	0	2	64
Stermac	(1995)	1	0	2	0	2	0	2	50
Ramin	(1992)	1	0	0	2	1	0	2	43
Bownes	(1991)	1	1	2	0	2	0	1	50
Satin	(1991)	1	2	2	0	1	0	2	57
Penttila	(1990)	1	0	1	1	2	0	1	43
Cartwright	(1989)	1	2	1	0	0	1	2	50
Goodyear-Smith	(1989)	1	0	2	2	2	0	2	64
Rodenas	(1989)	2	0	2	0	1	0	2	50
Cartwright	(1987)	2	1	2	0	0	0	2	50
Cartwright	(1986)	1	0	2	0	2	0	1	43
Olusanya	(1986)	1	1	2	0	2	0	1	50
Tintinalli	(1985)	1	0	1	2	2	0	2	57
Schiff	(1979)	1	0	0	0	1	0	2	29

0=not reported/not done 1=reported but inadequate or some gaps 2=reported and adequate

It was also anticipated that more recent studies would rate higher on quality scores as they would be more likely to build on prior research, have stronger designs and would be more likely to have specialized sexual assault examiner services and visualization adjuncts. The scores for the MINORS and SASQ were then compared based on the year of the study (Table 2-5). The studies were divided into those published before 2000 and those from 2000 until 2006. The median was approximately 60% across all years. The number of studies that scored less than 60% was then calculated for each category.

Table 2-5

Scores on MINORS and SASQ by Year of Study

	MINORS		SASQ	
Year of Study	*2000-2006*	*1979-1999*	*2000-2006*	*1979-1999*
Mean score (sd)	63 (10)	58 (9)	66 (15)	51 (14)
Median	67	58	68	50
# of studies scoring <60% (%)	10 (47)	14 (67)	8 (36)	17 (81)

The median MINORS scores were not substantially different between older and more recent studies. In contrast, the median score on the SASQ was much higher for recent studies compared to that of older studies.

Results

Injury Outcomes

The categories and rates of injuries were determined, including the proportion of women injured, injury rates by examiner types, numbers of injuries, injury severity and injury locations, injuries with police reporting, and injury detection by the number of hours between the assault and the exam. In instances where two subgroups were reported and data were available, these were treated as two study groups.

Injury Categories

Four major categories of injury emerged which were then used for the remainder of the review:

1. *no injuries.* Neither genital nor nongenital injuries were present;
2. *physical injury.* Subjects were included in this category if they had an injury of any type but the site was not identified (also referred to as "body trauma" or "any injury");
3. *genital injury (all).* Includes all studies in which subjects were reported to have genital injuries. Subjects with genital injuries may or may not also have had nongenital injuries and this was not always specified. One subgroup of studies was found within this category in which researchers formed mutually exclusive categories of "only genital injury" or "both genital and nongenital injury"; and

4. *nongenital injury (all)*. Includes all studies in which subjects had injury to nongenital regions of their body (also known as "body trauma"). Similar to the previous category, a subgroup of researchers in this category specified whether the injuries were "only nongenital" or "both nongenital and genital".

The definitions of "physical injuries" included presence of contusions (bruises), abrasions, lacerations, and penetrating injury across the studies. Physical injuries were also defined as including pain [49], pain and tenderness [50,51] and redness and tenderness.[52] The variety of injuries influences the variability in rates of injury and number of sites of injury.

Genital injury definitions were more uniform in the literature. Injuries included contusions, abrasions, lacerations, and penetrating injury as well as redness and swelling. Pain and tenderness were not included in any of the genital injury definitions of the studies included.

Proportion of Women Injured

The proportion of women with injuries was examined across the studies. Detailed results are available in Appendix A. Results for the three major injury groups (physical injury, genital injury or nongenital injury) are shown in Table 2-6. Approximately half of the women in each category had injuries of some type. The categories of injuries in the preceding data were not mutually exclusive – those with genital injuries may also have nongenital injuries or vice versa.

Table 2-6

Rate of Injuries Across All Studies

Injury Category	# of Groups	Total Women	Mean % (SD)	Median %	Min -Max (IQR)
Physical injury	23	7919	57 (18)	63	27-90
Genital-All	45	12303	45 (25)	45	5-85 (46)
Nongenital –All	27	9697	51 (14)	52	23-76

There was a subset of studies that had mutually exclusive categories of injury. They had either genital injury, nongenital injury, both genital and nongenital injury or neither.[27,32-34,53-56] The rates of injury for these studies are shown in Table 2-8. It is of note that approximately a third of women had no injuries at all and that only a quarter of women had both genital and nongenital injuries together. The presence of genital injuries without nongenital injuries was found to be less than 3% in one of the multivariate analyses.[25] The presence of genital injuries without nongenital injuries was found to be less than 3% in a multivariate analysis.[25] The authors found that presence of nongenital injury was an independent predictor of the presence of genital injury.

Table 2-7

Injuries in Studies with Mutually Exclusive Categories

Injury Category	# of Groups	Total Women	Mean % (SD)	Median %	Min-Max
No Injury	10	5388	35 (19)	30	11- 64
Genital Only	10	5628	19 (12)	19	3-37
Nongenital Only	10	5836	26 (16)	21	10-57
Both genital & nongenital injury	10	4950	29 (20)	26	3-68

Numbers of Injuries

Although injuries are anticipated with sexual assault, little is known about how many injuries might occur or how these compare to injuries with consensual intercourse.

Table 2-8 summarizes the mean number of injuries reported in the reviewed studies. The median number of injury sites was higher among studies reporting presence of genital injuries [57] compared to those with "physical" injury present.[13,49,51] There were no data available for the number of nongenital injury sites.

Table 2-8

Average Number of Sites of Injury

Injury Category	# Groups	Total Women	Avg Mean Sites (SD)	Median # Sites	Min- Max
Physical injury	8	1796	1.8 (.6)	1.5	1.2-2.7
Genital-all	6	1064	1.9 (1.0)	2.1	0.61-3.1

There is some clinical discussion that from the standpoint of long term consequences, it is not the mean number of injuries that are important in sexual assault, but the proportion that have more than one injury in a particular location (genital or nongenital). In Table 2-9, it can be seen that the greatest number of affected sites was among those with genital injury compared to nongenital sites.

Table 2-9

More than One Injury (All Studies)

Injury Category	# Groups	Total Women	Mean % (SD)	Median %	Min- Max
Physical	2	677	45 (9)	45	39- 52
Genital-All	4	487	51 (29)	54	20- 76
Nongenital-All	1	204	38	--	--

Severity of Injury

Injuries were considered severe if any of the following were present: internal injuries; fractures; head injuries or concussion; or overnight admission for injuries. Some authors reported only "mild" or "moderate" injuries, although definitions were not consistent and mainly subjective.[25,58,59] Injury data (Table 2-10) were available for the "severe" injury category for physical injury,[11,54,58] and for the number of women admitted for their injuries in each cohort group.[26,49,51] Genital and nongenital injuries were reported as mild, moderate or severe within each of two studies.[25,59]

Table 2-10

Severity of Injury

Injury Category	**Injury Severity**	**# Groups**	**Total Women**	**Mean % (SD)**	**Median**	**Min-Max**
Physical	Moderate	1	51	39	--	--
	Severe	3	386	14 (12)	18	1- 24
Genital	Mild	2	77	71 (15)	71	61-82
	Moderate	2	77	23 (13)	23	14- 33
	Severe	2	77	6 (3)	6	4-8
Nongenital	Mild	2	273	45 (50)	45	10-81
	Moderate	2	273	21 (4)	21	19-24
	Severe	2	273	33 (47)	33	0-66

There were more nongenital injuries classed as "severe" while genital injuries were more often "mild". The terms "mild" and "moderate" were not clearly defined, however, limiting the usefulness of comparisons. A weighted numeric severity index was developed and used in a group of Canadian studies, based on the total injuries multiplied by their relative weights for severity of the type of injury.[51] The injuries and their weights included: tenderness (1); pain (2); soft tissue injury such as bruises (3); lacerations (4); fractures (5); and internal injuries (6). The rank ordering of the weights was validated with 10 experts in sexual assault with 100% agreement. This severity index was used to study physical injuries based on the relationship with the assailant in two studies [50,60]. The severity of injury was greater in spousal assault than for assaults by acquaintances known more than 24 hours in both studies. Only one study, however, compared severity of injury between strangers and spouses.[50] The lowest severity of injury was among those assaults committed by acquaintances (2.3) and the highest severity was associated with spousal assaults (3.9). The severity of injury with stranger assaults was in between the two (3.2). The severity of injury was also compared between three age groups of women.[49] There was no significant difference in severity of injury between young, middle aged or older women.

Admission for injuries is another indicator of severity that was reported in a few studies[26,49,51] and one reported death from injuries[54] as shown in Table 2-11. All studies used an outcome of "physical" injury. No data were available for genital or nongenital injuries. Admission was relatively rare after sexual assault in the studies reviewed and death was even more uncommon. There was no information available on how many subjects were not admitted but yet could not be discharged from the Emergency or clinic until they received required further medical care beyond the standard sexual assault care.

Table 2-11

Outcomes After Sexual Assault

Outcome	# Groups	Total Women	Mean % (SD)	Median%	Min, Max
Admission	6	1147	6 (3)	4	3-10
Death	1	86	1	--	--

Injury Locations

The specific location of genital injuries was described in a number of the studies.[14,15,34,49,50,52,56,57,59,61-64] The highest rates of genital injury were at the posterior fourchette, hymen and anus (Table 2-12).

Table 2-12

Genital Injury Sites

Location	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Posterior Fourchette	6	870	42 (28)	44	7-81
Hymen	6	1041	26 (10)	28	11-39
Anus	9	1797	25 (25)	25	1-73
Labia Minora	2	136	15 (7)	15	10- 20
Perineum	2	228	13 (8)	13	8-19
Labia Majora	7	884	12 (13)	8	2-41
Vaginal wall	9	1832	24 (30)	6	2-89
Vestibule	1	249	21	--	--
Cervix	1	311	13	--	--

Nongenital injuries sites were reported as well.[14,26,49,50,56,57,59,62,63,65-67] The greatest percentage of nongenital injuries was found on the head and face, the lower legs and the torso (Table 2-13). The lowest rate of injuries was on the upper legs, buttocks and neck. There was considerable variability across most of the studies.

Table 2-13

Nongenital Injury Sites

Injury Site	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Head & Face	12	2037	26 (10)	28	13-41
Lower Legs	2	254	23 (28)	23	4-43
Torso	8	1003	23 (14)	22	5-49
Legs	4	1355	29 (23)	20	14- 63
Arms	6	1453	24 (23)	19	2-66
Neck	4	1442	18 (18)	16	1-38
Buttocks	2	341	13 (7)	13	8-18
Upper Legs	2	178	10 (10)	10	3, 17

Injury Types

Some authors combined different types of soft tissue injury in their analyses (Table 2-14). Soft tissue injury was defined as including bruising for some researchers[49-51,60] or bruises and abrasions.[14,15] In other studies, bruises and abrasions were reported separately.[25,26,34,57,68]

Table 2-14

Types of Injuries by Site

Injury Category	Injury Type	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Physical	Soft Tissue	8	1588	72 (3)	73	66- 76
	Lacerations	7	1205	49 (8)	47	36- 61
	Fractures	4	792	2 (.5)	2	2-3
Genital	Soft tissue	1	214	41	--	35-48
	Bruises	6	456	17 (13)	13	2-33
	Abrasions	6	456	34 (30)	22	10-88
	Lacerations	9	978	49 (27)	49	12-88
Non-Genital	Bruises	2	304	75 (3)	75	73-78
	Abrasions	2	218	69 (28)	69	49-89
	Lacerations	2	218	18(13)	18	9-28

Lacerations, the result of blunt force stretching and tearing tissue, were the most common physical and genital injury. Genital tissue, especially to the posterior fourchette has limited elasticity when blunt force is applied and is prone to tearing. The most common nongenital injury was bruises.

Redness and swelling were sometimes excluded from researchers' definitions of injury, as they were sometimes found less objective and more difficult to quantify or compare between raters especially if using photographs between raters.[15] Over quarter of adolescents were found to have genital redness[15] and over half of a mixed age group of women[68] had redness (Table 2-15). Only 6% of women in one study had genital swelling.[68] This low rate may be related to the relatively short time frame post-assault in which the women seek treatment, as swelling and bruising may not appear for hours or days after the assault.

Table 2-15

Genital Redness and Swelling

Type of Injury	# Groups	Total Women	Mean % (SD)	Median %	Min, Max
Redness	2	267	48 (20)	48	34-63
Swelling	1	53	6	--	--

A number of researchers also reported the presence or absence of tenderness and pain in the women that had physical injury.[49-51] Tenderness is commonly considered to be more objective than pain, as its presence may be demonstrated by an elicited response (e.g. wincing or withdrawal on palpation or touch). Pain, in contrast, is considered subjective and was not consistently measured in the research. Very few women reported having pain, but almost half had tenderness (Table 2-16).

Table 2-16

Tenderness & Pain with Physical Injuries

Sensation	# Groups	Total Women	Mean % (SD)	Median %	Min-Max (CI)
Tenderness	6	1183	47 (5)	47	40- 54
Pain	6	1183	16 (5)	18	7-22

Factors Influencing the Rate of Injury

Injury Rates by Examiner

The differential injury rates between examiners found in the initial review was supported (Table 2-17). The highest proportions of genital injuries were reported in studies in which SANEs completed the examination.[10,50,53,60,69] These proportions with SANEs were consistently higher than when sexual assault physicians completed the exams[11,49,51,58,59,65,70], or when Emergency physicians completed the exams.[26,71] There were negligible differences in rates of nongenital injury between the examiner groups.

Table 2-17

Injuries Detected by Examiners-All Studies

Injury Category	Type of Examiner	# of groups	Total Women	Mean % (SD)	Median %	Min -Max
Genital	SANE	21	7285	62(22)	68	9-85
	SA MD	10	1163	35 (19)	26	16-65
	ER MD	6	935	21(12)	25	5-32
Nongenital	SANE	12	6077	53 (15)	56	25-76
	SA MD	7	984	53 (16)	57	23-72
	ER MD	3	486	50 (10)	54	39-57

There were more pronounced differences in injury detection between examiners when the review was limited to studies that had mutually exclusive categories of injury (Table 2-18).

Table 2-18

Injuries Detected by Examiners-Exclusive Injury Category Subset

Injury Category	Type of Examiner	# of groups	Total Women	Mean % (SD)	Median %	Min -Max
None	SANE	5	4150	24 (13)	18	11-42
	ER MD	2	343	46 (25)	46	28-64
Genital	SANE	5	4150	22 (12)	22	4-37
	ER MD	2	343	8 (4)	8	5-11
Nongenital	SANE	5	4150	22 (20)	14	10-57
	ER MD	2	343	33 (8)	33	28-39
Both Injuries	SANE	5	4150	32 (17)	31	11-54
	ER MD	2	343	12 (13)	12	3-22

Among the subset of studies with mutually exclusive injury categories there were only data available for studies with SANEs [33] and with Emergency physicians.[34,55] There were no studies in this subset in which sexual assault physicians completed the exams. Very few patients were found to be injury free when SANEs conducted the examinations compared to almost half of women examined by the Emergency physicians. The SANE studies reported three times the number of genital injuries compared to the Emergency physicians. In contrast, the Emergency physicians reported twice as many nongenital injuries as SANEs.

The use of adjuncts to visualize the injuries, such as colposcopy with magnification or toluidine blue dye, may help explain the higher rates of genital injury detection by SANEs compared to sexual assault physicians found in this study. Over half of the studies involving SANEs reported using at least one adjunct to visualization (Table 2-19).

Table 2-19

Examiner Type and Adjunct Use in Genital Injury Studies

Visualization Adjunct	**SANE (%)**	**SA MD**	**ER MD**
Toluidine & colposcopy magnification	9 (42.5)	0	0
Colposcopy with magnification	1 (5)	0	0
Toluidine dye only	2 (10)	0	0
No adjuncts	0	0	1 (17)
No adjuncts described	9 (42.5)	11 (100)	5 (83)

All the studies in which visualization adjuncts were used had SANEs.[35,52,53,56,57,66] None of the studies involving sexual assault physicians or Emergency physicians reported using either adjunct.

Injury by Time between Assault and Exam

In one of the studies it was found that the number of women with genital injuries who were seen within 24 hours post-assault was seven times more likely than if the women were seen more than 24 hours later.[35] The rate of injuries in relation to the number of hours between the assault and the examination is shown in Table 2-20. There was very little difference in injury by time seen in the "physical injury" category, although there was only one study.[70] The majority of studies reported genital injury rates within 24 hours post-assault.[27,34,35,56,70] There were more genital injuries detected if women were seen within less than 48 hours compared to 24 hours, although there was only one study reporting injuries in women seen mainly within 48 hours[56] and it involved a very small sample size.

Table 2-20

Injuries and Hours between Assault and Exam

Injury Category	**Hours - Assault to Exam**	**Total # Groups**	**Total Women**	**Mean % (SD)**	**Median**	**Min-Max**
Physical	< 24 hrs	1	608	32	--	--
	<48 hrs	1	234	36	--	--
	<72 hrs	--	--	--	--	--
Genital	< 24 hrs	5	1121	48 (36)	34	34-78
	<48 hrs	1	18	67	--	--
	< 72 hrs	1	193	14	--	--

Nongenital injuries and hours since the assault were only reported in one study.[27] There were only minimal differences seen in the rate of injury if women were seen in less than 24 hours (53%) versus within 48 hours (46%).

Injuries and Police Reporting

The setting in which women access sexual assault care may impact the rate of injuries. Women were found in one study to be 3.5 times more likely to report to police if injuries were present.[6] Settings varied in the studies reviewed. Some described optional police reporting (e.g. Emergency or clinics) while others only reported cases in which women had to report to police (e.g. police funded clinic). The rate of injuries was expected to be greater in mandatory reporting settings but was actually greater in optional reporting settings (Table 2-21). It was not clear from these studies how many women in the optional settings decided to report to police.

Table 2-21

Injuries by Police Reporting Settings - All Studies

Injury Category	Police Reporting	# Groups	Total Women	Mean % (SD)	Median	Min-Max
Physical	Mandatory	5	2961	51 (26)	34	32-90
	Optional	18	4958	58 (15)	63	27-76
Genital	Mandatory	13	2457	41 (23)	32	8-81
	Optional	28	9359	46 (26)	46	5-85
Non-Genital	Mandatory	9	1840	48 (16)	49	23-72
	Optional	18	7857	52 (13)	53	25-76

When mutually exclusive categories of injury are examined, there were higher rates of women in mandatory settings who had only nongenital injury (Table 2-22). In contrast, the rates of women who had both genital and nongenital injury were greater among women seen in the mandatory reporting settings. Again the rates of reporting to police were not clear among the optional sites.

Table 2-22

Injury Rates by Police Reporting Settings –Exclusive Injury Categories

Injury Category	Police Reporting	# Groups	Total Women	Mean % (SD)	Median	Min-Max
None	Mandatory	5	1259	40 (20)	33	17-64
	Optional	5	4577	32 (18)	33	11-57
Genital	Mandatory	5	1259	16 (8)	18	5-26
	Optional	5	4517	16 (14)	16	3-37
Non-genital	Mandatory	5	1259	22(11)	15	13-39
	Optional	5	4577	31 (20)	28	10-57
Both injuries	Mandatory	5	1259	22 (15)	22	3-42
	Optional	5	4577	21 (19)	13	5-54

Only a few of the studies included an analysis of injuries between those who reported to police and those who did not report.[6,34,72] These are summarized in Table 2-23. The rates of physical and nongenital injury were much higher in those reporting to police compared to those not reporting. There were minimal differences in rates of genital injury.

Table 2-23

Injuries by Decision to Report to Police

Injury Category	Police Reporting	# Groups	Total Women	Mean % (SD)	Median	Min-Max
Physical injury	Reported	1	90	78		69-86
	Not reported	1	82	41		31-52
Genital	Reported	2	1180	50 (11)	50	42-58
	Not reported	2	343	46 (25)	46	28-64
Nongenital	Reported	1	94	69		60-78
	Not reported	1	62	47		34-59

The data from the two relevant studies with genital injury were examined using a chi-square analysis. There was no significant difference in injured and noninjured women between reporting and non-reporting groups ($\chi2=0.003$, $p=0.9$). Unfortunately the pooled sample size was comparatively small (Table 2-24). Within study comparisons, however, have shown that women who reported were significantly more likely to have clinically observed injuries and to have experienced greater force in the assault.[6]

Table 2-24

Comparison of Genital Injuries if Reported vs. Not Reported

	No Injuries	Injuries	Totals
Not reported	84	31	115
Reported	211	79	290
Totals	295	110	405

Biographic Risk Factors for injury

The biographic risk factors included indicators of physical maturity (age and prior sexual experience); sociocultural indicators (race, socioeconomic status); chronic vulnerability (psychiatric diagnoses); and impaired consciousness (substance use; and level of consciousness).

Age

There was wide variation in injury rates across all age groups (Table 2-25) Physical injury rates were highest in studies with cohorts of women 40 years of age and older.[10,49] This was also found in a multivariate analysis injury.[69] Genital injury rates were highest at either end of the age spectrum,[13,26,27,32-35,67] involving mainly adolescents (15 to 19 year olds) and women aged 40 years or older. Nongenital injury rates were highest in all groups of women age 20 years or older.[27,32,33,59,73] Adolescents had much lower rates of nongenital injuries.

Table 2-25

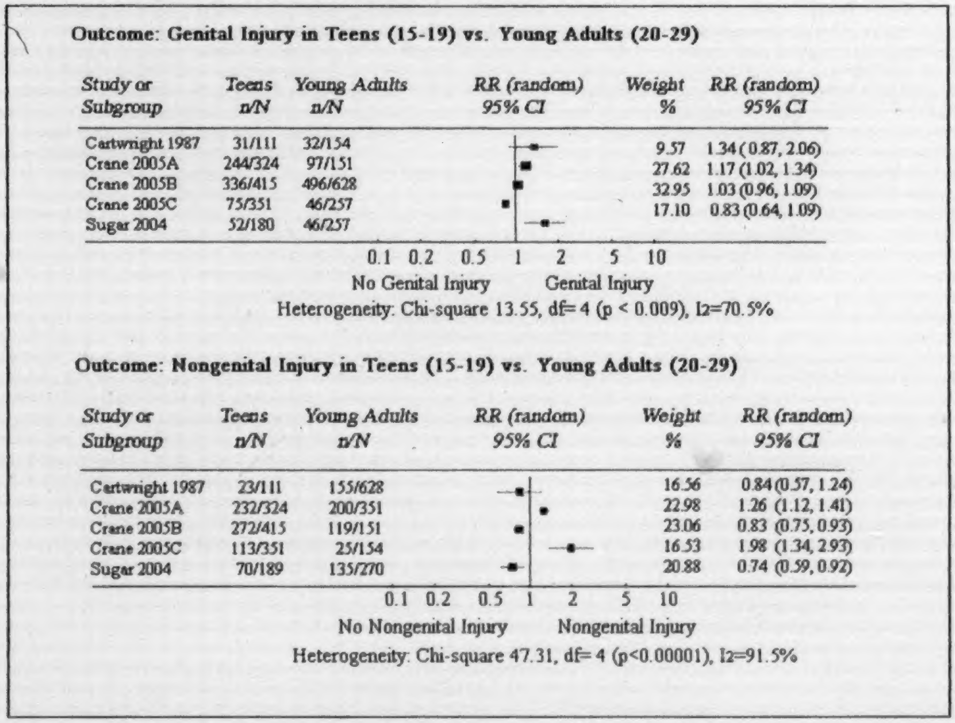
Injuries by Age

Injury Category	**Age in Years**	**# Groups**	**Total Women**	**Mean % (SD)**	**Median %**	**Min-Max**
Physical	15-19	1	113	27	--	--
	20-29	2	256	54 (16)	54	43-66
	40-49	1	61	66	--	--
	≥ 50	1	73	66	--	--
Genital	10-14	2	98	45 (49)	45	10-80
	15-19	8	1911	55 (28)	57	21-84
	20-29	5	1541	41 (28)	26	18-79
	30-39	6	1042	35 (25)	33	8-69
	40-49	6	495	47 (29)	47	14-80
	≥ 50	7	314	51 (19)	50	29-77
Nongenital	15-19	5	1390	46 (22)	37	21-72
	20-29	5	1554	45 (25)	50	16-79
	30-39	6	1073	45 (24)	45	11-77
	40-49	5	478	55 (21.4)	56	25-78
	≥ 50	7	340	53 (14.9)	55	25-68

Age Comparisons - Adolescents versus Adults

The young adults had the lowest median rate of genital injury and were therefore used as a control group for comparisons. Their injury rates were compared to teens and adults over 40 years old (Figure 2-2).

Figure 2-2. Teen vs. Young Adult Injuries



Outcome: Genital Injury in Teens (15-19) vs. Young Adults (20-29)

Study or Subgroup	*Teens n/N*	*Young Adults n/N*	*RR (random) 95% CI*	*Weight %*	*RR (random) 95% CI*
Cartwright 1987	31/111	32/154		9.57	1.34 (0.87, 2.06)
Crane 2005A	244/324	97/151		27.62	1.17 (1.02, 1.34)
Crane 2005B	336/415	496/628		32.95	1.03 (0.96, 1.09)
Crane 2005C	75/351	46/257		17.10	0.83 (0.64, 1.09)
Sugar 2004	52/180	46/257			

Heterogeneity: Chi-square 13.55, df= 4 (p < 0.009), I2=70.5%

Outcome: Nongenital Injury in Teens (15-19) vs. Young Adults (20-29)

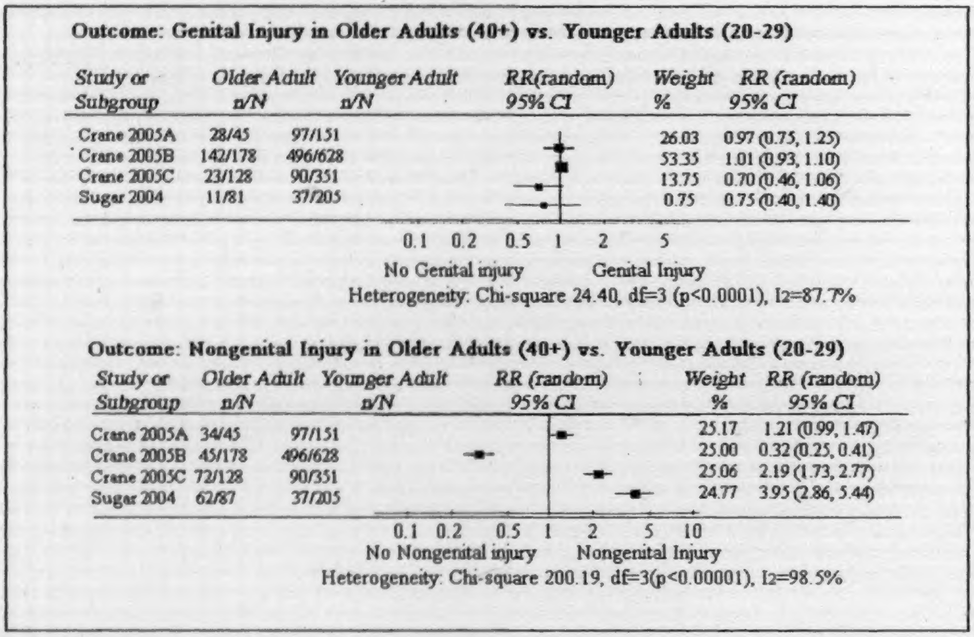
Study or Subgroup	*Teens n/N*	*Young Adults n/N*	*RR (random) 95% CI*	*Weight %*	*RR (random) 95% CI*
Cartwright 1987	23/111	155/628		16.56	0.84 (0.57, 1.24)
Crane 2005A	232/324	200/351		22.98	1.26 (1.12, 1.41)
Crane 2005B	272/415	119/151		23.06	0.83 (0.75, 0.93)
Crane 2005C	113/351	25/154		16.53	1.98 (1.34, 2.93)
Sugar 2004	70/189	135/270		20.88	0.74 (0.59, 0.92)

Heterogeneity: Chi-square 47.31, df= 4 (p<0.00001), I2=91.5%

The starting point for the older age group was set at 40 years, as peri-menopausal changes may begin around that age, including changes such as altered skin elasticity and decreased underlying connective tissue. Both of these changes may affect injury risks. As shown, the relative risk for genital injury in teens was slightly greater than one in almost all studies compared to young adults. There is no real pattern of risk among the studies included in either the genital or the nongenital injury analysis. The heterogeneity indices were 70.5 and 91.5% therefore results were not pooled.

The older adults had either less risk of genital injury or only minimal differences compared to younger adult women across the four groups compared in Figure 2-3. In two studies there was actually a lower risk of genital injury if women were over 40 years old than for the younger women.[27,33]. The majority of studies had greater relative risks for nongenital injury in older adults compared to younger adults. In both genital and nongenital analyses, however, the I^2 again was greater than 75% in all cases so results were not pooled. As noted earlier, within study comparisons did not reveal any significant differences in severity of injury among young, middle aged or older women.[49]

Figure 2-3. Older Adult vs. Young Adult Injuries



Outcome: Genital Injury in Older Adults (40+) vs. Younger Adults (20-29)

Study or Subgroup	*Older Adult n/N*	*Younger Adult n/N*	*RR(random) 95% CI*	*Weight %*	*RR (random) 95% CI*
Crane 2005A	28/45	97/151		26.03	0.97 (0.75, 1.25)
Crane 2005B	142/178	496/628		53.35	1.01 (0.93, 1.10)
Crane 2005C	23/128	90/351		13.75	0.70 (0.46, 1.06)
Sugar 2004	11/81	37/205		0.75	0.75 (0.40, 1.40)

Heterogeneity: Chi-square 24.40, df=3 (p<0.0001), I2=87.7%

Outcome: Nongenital Injury in Older Adults (40+) vs. Younger Adults (20-29)

Study or Subgroup	*Older Adult n/N*	*Younger Adult n/N*	*RR (random) 95% CI*	*Weight %*	*RR (random) 95% CI*
Crane 2005A	34/45	97/151		25.17	1.21 (0.99, 1.47)
Crane 2005B	45/178	496/628		25.00	0.32 (0.25, 0.41)
Crane 2005C	72/128	90/351		25.06	2.19 (1.73, 2.77)
Sugar 2004	62/87	37/205		24.77	3.95 (2.86, 5.44)

Heterogeneity: Chi-square 200.19, df=3(p<0.00001), I2=98.5%

Prior Sexual Experience

A number of researchers examined injuries with or without prior sex in adolescents,[15,64] in adolescents and young adults,[74] in mixed adolescent and adult populations,[27,34,61] and in groups of pregnant and non-pregnant women.[71] The median number of women injured was actually higher among women who had prior sexual experience (Table 2-26).

Table 2-26

Genital Injury and Prior Sexual Experience

Prior Sex	# Groups	Total Women	Mean % (SD)	Median %	Min- Max
No	7	609	50 (28)	39	19- 91
Yes	7	1458	45 (29)	53	3-74

The injuries related to prior sexual experience were not consistently grouped by age. For this review the studies were grouped into those involving only adolescents, those with adolescents and young adults, and those including adolescent to older adults (Table 2-27). Differences were minimal in the rate of genital injuries among adolescents regardless of prior sexual experience. The largest differences in genital injuries were seen if the groups included adult women (young or older) without prior sexual experience.

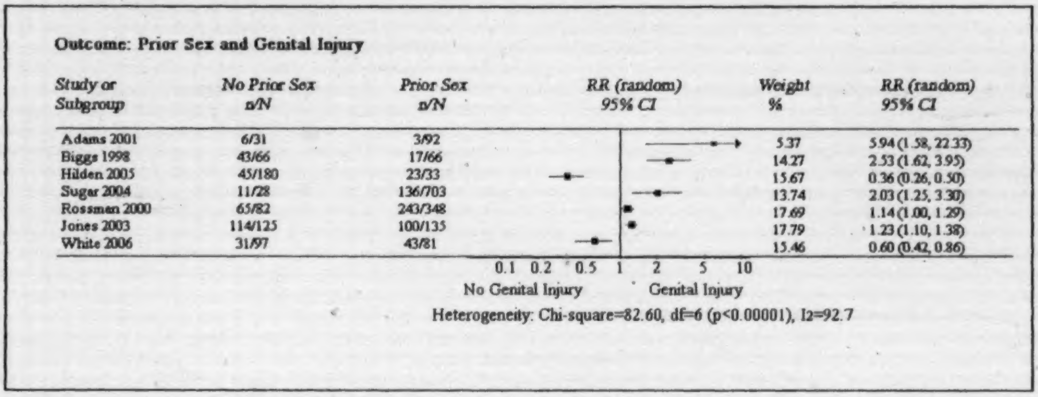
Table 2-27

Age, Prior Sex Experience and Genital Injury

Age Group	Prior Sex	Study #	Total Women	Mean % (SD)	Median %	Min-Max
15-19 years	No	2	128	35 (9)	25	19-32
	Yes	2	173	28 (35)	28	3-53
15-29 years	No	2	207	85 (8)	85	79-91
	Yes	2	483	72(3)	72	70-74
15-50+ years	No	3	274	43 (20)	39	25-65
	Yes	3	802	38 (28)	26	19-70

Meta-analysis was used to examine differences within and between studies (Figure 2-4). The heterogeneity between studies overall prevented pooled comparisons. The relative risk in most of the studies indicated the anticipated effect of prior sex on genital injuries – women were more likely to be injured if they had not had prior sex in 5 of the 7 studies included. The studies in the table are ordered in ascending order of mean participant age. The top three studies involved the adolescent females. The relative risk of injury varies widely, from 0.60 to 5.94. The relative risk of genital injury is somewhat more consistent among the studies involving mixed adolescent and adults.

Figure 2-4. Prior Sexual Experience and Genital Injury Meta-analysis



Race

Race was not a predictor of physical injury in a study with a mainly White and Black population.[69] There were differences in races of women affected in studies examining both genital injury[32,33,35,67] and nongenital injury.[32,33,67] Genital injury rates were highest in White women and then in Blacks (Table 2-28).

Table 2-28

Racial Group and Injury

Injury Category	Race	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Genital	White	6	2321	56 (23)	62	26-80
	Black	6	1143	48 (33)	50	8-86
	Hispanic	3	417	43 (39)	50	0-78
	Aboriginal	2	22	41 (58)	41	0-82
	Asian	2	8	10 (14)	10	0-20
	Non-white	*6*	*1590*	*47 (32)*	*49*	*8-86*
Nongenital	White	5	2260	46 (28)	59	8-75
	Aboriginal	2	22	54 (13)	54	45-64
	Black	5	1065	37 (17)	38	17-62
	Hispanic	3	417	27 (25)	27	0-50
	Asian	2	8	26 (9)	26	20-33
	Non-white	*5*	*1512*	*37 (12)*	*38*	*24-54*

White women again had the highest rates of nongenital injuries but it was Aboriginal rather than Black women who had the next highest rates of nongenital injury.[33] There were very few Aboriginal women described in any of the studies, most of which were from the United States.

Socioeconomic Status

Only one study had injury data available based on socioeconomic status or employment.[34] The highest rate of genital injury was among employed women (38%) compared to those on welfare (23%). In a multiple regression analysis of assault characteristics,[50] homelessness was one of the factors that predicted assault by a stranger. Differences in physical injuries in relation to homeless status were not reported.

Psychiatric Disorders

A limited number of studies included data on the rate of injuries among women with or without major psychiatric diagnoses (Table 2-29). These diagnoses included posttraumatic stress disorder and depression.[27,58,75] There were no differences in genital injury but there were more women with nongenital or "physical" injuries who had psychiatric disorders.

Table 2-29

Genital Injury and Psychiatric Diagnosis

	Psychiatric Diagnosis	**# of groups**	**Total Women**	**Mean (SD)**	**Median %**	**Min-Max**
Physical	No	1	6	40	--	--
	Yes	1	26	72	--	--
Genital	No	2	957	25 (1)	25	25-26
	Yes	2	559	22(2)	22	21-24
Non-Genital	No	1	608	49	--	--
	Yes	1	211	59	--	--

Substance Use

Only a few studies reported injuries associated with alcohol or drug use, limiting comparisons.[27,34,53] There was a minimal difference in the proportion of women with genital injuries regardless of the presence of alcohol use (Table 2-30). The percentage of women with nongenital injuries was higher if any substance (alcohol or drugs) was used prior to the assault than when nothing was used.

Table 2-30

Mean Number of Injuries by Substance Use

Injury Category	**Alcohol or Substance Use**	**# Groups**	**Total Women**	**Mean (SD)**	**Median %**	**Min-Max**
Genital	No substances	1	76	30	--	--
	Any alcohol use	1	133	35		
Nongenital	None	2	783	40 (2.8)	40	38-42
	Any Substance	2	615	57 (1.4)	57	56-58
	Drug Use	1	184	58	--	--

One study reported genital injury based on the extent of alcohol use.[34] There was minimal difference in the rates of injury between those with moderate alcohol use (32%) compared to those with heavy alcohol use (38%). There was no indication of the degree of impaired consciousness with these levels of intake however.

Impaired Consciousness

The rate of injuries was reported if women were markedly intoxicated or unconscious in only two studies.[34,35] The median injury rate was 53% (range 19-83%) and the sample sizes were very low in both studies. In the one study that compared levels of intoxication,[35] the genital injuries were only marginally different between those not intoxicated (80%) and those markedly intoxicated (88%).

Only one study contained data on nongenital injuries and intoxication [35]. Among the 431 women in the study more women had nongenital injuries if they reported being mildly intoxicated at the time of the assault (56%) compared to those who were not intoxicated (42%).

Contextual Risk Factors for Injury

The contextual risk factors identified included the time of day; relationship of the assailants to the women; and the privacy of the setting in which the assault took place.

Time of Day

Injuries associated with time of day were only reported in two studies.[34,35] No difference was apparent in the rates of women with genital injuries for any of the times groupings (Table 2-31). Data were not available for nongenital injury by time of day.

Table 2-31

Genital Injuries by Time of Day

Time of Day of Assault	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Early am to noon	2	115	58 (42.4)	58	28-88
Noon to supper	2	83	57 (26.9)	57	38-76
Supper to early am	2	260	57(33.9)	57	33-81

Relationship

The proportion of injured women was examined based on their relationship to the assailant (Table 2-32) including whether the assailant was known or unknown to the women.[27,32-34,50,60]

Table 2-32

Injuries by Relationship to Assailant

Injury Category	**Relationship of Assailant**	**# Groups**	**Total Women**	**Mean % (SD)**	**Median %**	**Min-Max**
Physical	Unknown	4	1022	55 (21)	58	27-76
	Known	4	1401	55 (15)	57	35-70
	-known < 24 hrs	--	--	--	--	--
	-known >24 hrs	4	918	50 (11)	54	35-59
	-intimate partner	2	689	74 (3)	74	72-76
Genital	Unknown	6	1307	49 (30)	48	17-79
	Known	7	4289	52 (27)	59	14-82
	-known <24 hrs	1	62	42	--	--
	-known > 24 hrs	3	316	44(35)	34	15-83
	-intimate partner	4	149	40 (28)	37	11-75
	-family member	1	12	50	--	--
Non-genital	Unknown	5	1356	55 (19)	52	28-77
	Known	5	3222	52 (19)	58	23-73
	-known < 24 hrs	--	--	--	--	--
	-known >24 hrs	2	579	41(7)	41	36-46
	-intimate partner	3	189	49(17)	56	30-62

The "known" category included assailants known at least 24 hours and intimate partners. Rates of physical injury and nongenital injury were similar between known and unknown assailants, while there was more genital injury if assailants were known.

The injury rates were then examined in terms of subgroups of known assailants. Physical injury rates were greater if the assailant was an intimate partner versus a stranger while genital injury was greater with strangers versus intimate partners. There were no differences in nongenital injury rates between strangers and intimate partners.

Some researchers examined specific groups of known relationships compared to strangers.[32-35,50,51,53,56,58] The rate of injury in these studies was greater for genital and particularly for nongenital injuries if the assailant was an intimate partner (current or former boyfriend or spouse) compared to an acquaintance or stranger.

The mean number of physical injuries (Table 2-33) was significantly higher in assaults by intimate partners compared to strangers or recent acquaintances within the same study [50] and between strangers and known assailants in another.[51] Mean numbers of genital injuries were only reported in one study.[60] There was no difference in the number of genital injuries if assaulted by intimate partners (1.3, SD 0.7) compared to acquaintances (1.3, SD 0.6). Comparison data for numbers of genital injuries with stranger assaults were not available.

Table 2-33

Physical Injuries by Relationship

Relationship	# of Groups	Total N	Mean # Injuries	SD
Stranger	2	563	0.7	0.7
Known	1	456	1.5	--
Acquaintance >24 hrs	1	326	1.0	1.1
Intimate	1	336	1.5	1.3

Setting

There were data on where assaults took place in many of the studies, but very few had data on how many women were injured in each setting. In one study (n=249), approximately 36% of women had genital injuries when the assault occurred in a home compared to 24% with injuries if assaulted in a public place.[34] Nongenital injuries were found in 70% of women who were assaulted in vehicles in another study of 819 women.[27]

Assault Risk Factors

The assault associated with risk of injury included resistance; aggression (physical, verbal); number of assailants; weapons; penetration (site and object used); position and lubrication.

Resistance

The severity of physical injury (none, minor or major) was analyzed in relation to physical and verbal resistance and women's relationship with the assailants [69] or with multiple versus single assailants.[76] Physical injury was greater in both studies if women used physical resistance. Physical resistance was found to decrease the likelihood of penetration with single assailants.[76] The use of physical resistance was more effective in avoiding stranger assaults than assaults by known individuals.[69] It was found in the same study that the effect of resistance on injury was almost three times greater for stranger assailants than for known assailants. They also found that more physical resistance was used for known assailants than strangers and less was used if the assailants had weapons or there were multiple assailants, while verbal resistance did not have an impact on injury severity or assault avoidance. In another study it was found that if women did not fight multiple assailants that there was greater physical injury.[76]

Only one study reported the rate of genital injuries in relation to women's resistance to the assailant.[35] There were fewer women with genital injuries if they reported being immobilized during the assault (67%) compared to those that used either verbal or physical resistance (81%) or both (84%), although the rate of injury was still relatively high among women who did not resist at all (79%). Data were not available on nongenital injury and resistance. Multivariate analysis revealed a significant association between the use of any resistance (verbal or physical) and the presence of genital injury.

Aggression

Aggression by the assailant can either be physical or verbal. Physical aggression or use of force was reported in relation to rates of genital injuries [34,35] and of nongenital injury.[27] Forms of physical aggression were defined as mild if they used restraints, moderate if there was injury present [34] or severe if there was grievous harm or strangulation [34] or kicking and hitting as severe and attempted strangulation reported separately.[27] The terms “mild”, “moderate” and “severe” were used in one study but the categories were not defined.[35] There was minimal difference between the use of any level of physical force and the proportion of women with genital injuries and there was wide variation in the results (Table 2-34).

Table 2-34

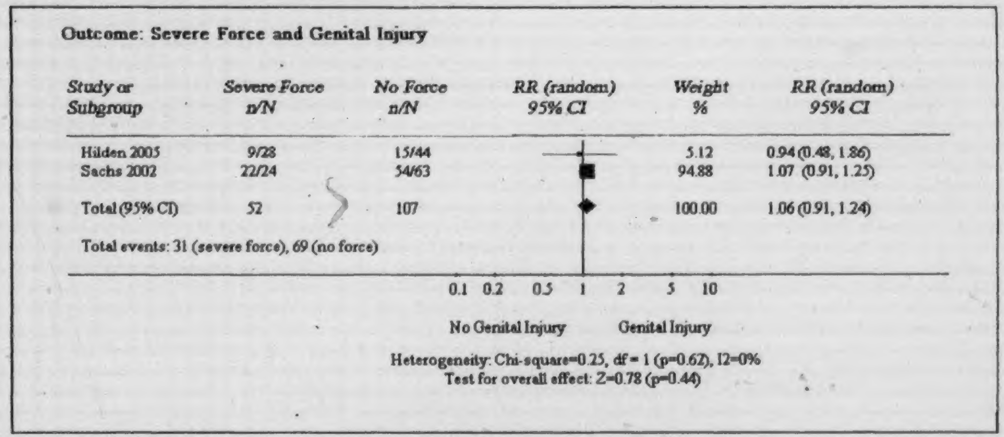
Force and Genital Injury

Injury Category	Force	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Genital	No force	2	107	60 (37)	60	34-86
	Mild force	2	214	55 (31)	55	33-77
	Moderate force	2	88	52 (40)	52	24-81
	Severe force	2	52	62 (42)	62	32-92
Nongenital	Severe force	1	214	84	--	--
	Strangulation	1	99	81	--	--

The study which reported the highest rates of injury was the one in which examiners were dedicated sexual assault examiners, either SANE or specially trained MD’s.[35] The study reporting the lowest injury rates used general duty physicians to complete the examinations.[34] The percentage of women with nongenital injuries was high in both studies when severe force was used. The highest rates of either type of injury were seen when severe force was used or there was attempted strangulation.

A comparison of injuries within studies was conducted using Review Manager (Figure 2-5). There was only a marginal increase in the genital injuries with the use of force across the studies. There was no heterogeneity between the studies. The pooled relative risk for injury with force was 1.06.

Figure 2-5. Force and Genital Injury



The use of physical aggression has been linked to more severe physical injury.[51,60] The context in which more physical aggression occurs is not clear however. Greater use of physical aggression has been linked both to stranger assaults in adolescents [77] and adults [51] as well as to intimate partner assaults.[60,78]

Verbal threats were a predictor of nongenital injury in a multivariate analysis.[25] It is not clear the circumstances under which verbal threats occur more often however. They have been linked to both acquaintance assaults [58,78] as well and stranger assaults.[70] The role of verbal aggression in genital injury is not clear.

A coercion index has been developed by a group of Canadian researchers.[50] Weights are assigned for each of the forms of coercion used by assailants: assault while sleeping (1); verbal threats (2); drug facilitated assault (3); restraints (4); use of physical force (5). The mean index was found to be highest in assaults committed by spouses or partners, then by strangers and lowest among assaults involving assaults by acquaintances known for more than 24 hours.[50] The mean coercion was also found to be highest in assaults against younger women.[49] The use of physical restraints, violence and threats did not differ between the groups. The key difference was that younger women more commonly had weapons involved. Data were not available on the proportions of injuries directly related to the coercion index.

Number of Assailants

The rate of injury was compared between those women assaulted by single versus multiple assailants (Table 2-35).

Table 2-35

Number of Assailants and Injury

Injury Category	**# Assailants**	**# Groups**	**Total Women**	**Mean % (SD)**	**Median %**	**Min-Max**
Physical	Single	3	2712	32 (0.6)	32	32-33
	Multiple	3	926	37(0.1)	37	37-37
Genital	Single	4	2902	50 (28.4)	51	21-78
	Multiple	5	498	47 (19.3)	48	23-72
Nongenital	Single	4	3319	49 (21.3)	48	24-76
	Multiple	4	528	51 (18.1)	56	26-67

The rates of women with injury in any physical location were not appreciably different between those with single or multiple assailants[76], regardless of the subgroup examined. Similarly, the number of women with genital injuries was not very different between single and multiple assailants.[33,34,63] More women had nongenital injuries if there were multiple assailants rather than single assailants.[27,33]

Weapon Use

Various types of injury were examined when weapons were present or absent (Table 2-36). There were fewer women with genital injuries if a weapon was present than if it was absent in both mixed age populations [33] and in elderly populations.[79] In contrast, there were more women with nongenital injuries if a weapon was present.[33] In a multivariate analysis of physical injury, the presence of a weapon was an independent predictor of increased injury.[69]

Table 2-36

Injuries with Weapons

Injury Category	Weapon	# Groups	Total Women	Mean % (SD)	Median %	Min-Max
Genital	No weapon	4	2524	57 (24)	63	23-77
	Any weapon	4	815	48 (25)	46	19-80
Nongenital	No weapon	4	3044	48 (21)	47	24-75
	Any weapon	4	970	52 (17)	54	29-69

Penetration

Most studies had inclusion criteria that required completed penile penetration. One study reported genital injuries with various sites of penetration [35], finding the rate of injury was reported to be seven times more likely with anal penetration than with vaginal penetration. As shown in Table 2-37, anal penetration was associated with high rates of genital injury [34], although there was wide variation. The rate of genital injury with vaginal-penile penetration was significantly lower [32,34,80]. The highest rate of physical injury (64%) was among women with attempted penetration, although there was a very small sample size [56]. There was some confusion with the category of "no penetration" in one study [35]. Completed penetration (vaginal-penile or anal-penile) was a requirement for women to be included in their study yet they reported a category of women labeled as having "no penetration". It was not clear if this category actually referred to attempted penetration. All 26 women in this group (100%) sustained genital injuries.

Table 2-37

Injuries with Sites of Penetration

Type of Penetration	**# Groups**	**Total N**	**Mean % Injured (SD)**	**Median %**	**Min-Max**
Attempted	1	14	64	--	--
Oral	1	213	15	--	--
Vaginal	3	123	23 (7)	21	17-31
Anal	4	168	50 (31)	40	26-93
Anal & Vaginal	1	18	6	--	--
Any penetration	1	136	78	--	--

Nongenital injuries were reported after different forms of penetration in only one study.[27] Injuries were found in 61% of women who reported oral-penile penetration (n=196) and in 63% of women who reported anal-penile penetration (n=145).

Object Used to Penetrate

Many of the studies described the types of objects used to penetrate the women in their cohort, but only a few reported injuries that results from each object. In one study the injury rates were reported for digital (finger), penile and foreign body penetration [56] and another reported injuries with digital penetration.[68] The higher rate of injury with digital penetration was obtained from a study with digital injury as its main outcome (Table 2-38).

Table 2-38

Genital Injuries and Object Used

Object	**# Studies**	**Total Women**	**Mean % (SD)**	**Median %**	**Min-Max**
Digital	2	134	62 (27)	62	43-81
Penis	1	53	80	--	--
Foreign Object	1	213	8	--	--

Position during Assault & Genital Injuries

Only one study reported data on the number of genital injuries found with various positions of the women during the assault.[35] Most of the women were lying on their backs (n=127) and 81% of them sustained genital injuries. Multiple positions were reported by 53 women and 81% of this group also had genital injuries. Only five women reported being in a standing position during the assault and all had genital injuries (100%). There were seven women in the study who were on their stomachs during the assault and 71% had genital injuries.

Lubrication & Genital Injuries

The use of lubricant and genital injuries was reported in one study.[35] When no lubrication was used, 79% of the women (n=185) had genital injuries compared to 87% of the women (n=24) with injuries when lubrication was used. The number of women in the group using lubricant was quite small, as would be expected during a sexual assault.

Discussion

There were four main questions to be addressed in this review: quality of the evidence, rates and severity of injury; factors affecting variability of injury rates; and the influence of biographic, contextual and assault factors on injury outcomes.

Quality of the Evidence

All of the included studies involved retrospective cohorts. The two quality scores were comparable, with median scores of approximately 60%. More recent studies had higher scores on the SASQ although the MINORS scores were not markedly different between recent and older studies. This difference most likely reflects the more clinical focus of the SASQ. The main focus of the MINORS is on research design issues, which have remained similar across the years. In contrast the SASQ reflects clinical aspects such as the population, setting, timing of the examination and the skills or techniques used by the examiners. These would be expected to improve over time, especially as specialized sexual assault services expand.

The use of cohort designs limits the ability to make causal inferences. The potential for inference, however, is strengthened if there is consistency of results across studies and populations.[81] It was seen in many areas that there were consistent results although the numbers of studies and women studied remained small. There were only a limited number of multivariate studies in which relationships between risk factors were explored.

Injury Rates and Severity

There was considerable variability in the rates of injury reported across the 43 studies and a wide range of risk factors reviewed. Overall there were slightly more women with nongenital injuries (52%) than genital injuries (45%) when all studies were combined. When exclusive groups of injury were examined, there were only small differences in rates with approximately a quarter of women having genital, nongenital or both types of injury. Those with nongenital injury were more likely to have genital injuries. The relative lack of difference in the few studies reporting exclusive categories may be due to systematic differences in injury definitions between these and the larger number of studies.

There were more women who had more than one genital injury compared to nongenital injury although genital injuries were most often considered "mild". The greater number of injured sites may reflect the relative fragility of genital tissues in comparison to nongenital structures.

Methods of estimating severity of injury varied but in general nongenital injuries were found to be more severe than genital injuries. The rates of admission and death from sexual assault injuries were extremely low. While very few women are admitted with their injuries, it was seen that nongenital injuries can be severe. It is unknown how many women had to remain in the health care setting for further care of those injuries. In one Danish study, 11% of patients required further care [72] as did approximately 20% percent of women in a large American study.[82]

Severe physical injuries were more likely to be found when the assailant was a known or intimate partner. Sexual assault is sometimes seen in the context of an abusive relationship, most likely explaining the link between severity and the relationship with the assailant. The variations in categorizing injuries influenced the ability to assess severity. For instance, the terms "abrasions" and "lacerations" were used interchangeably in a few studies.[15,61] The mechanism of injury is blunt force trauma for lacerations, while it is friction or pressure for abrasions.[19] These differences imply varying levels of severity and the injuries cannot be considered similar in severity.

Almost half of women had redness while very few had swelling. This difference would support the finding that many women had tenderness but few had pain with their injuries. If they present within 24 to 48 hours of the assault they are less likely to have a pronounced inflammatory response, decreasing the likelihood that mechanical pain receptors would be activated. In contrast, palpation of affected areas would elicit a tenderness response.

It is also of note that at least a third of women had no injuries of any type. This further dispels the myth that injuries must be present. If injuries were present, the majority of women did not have pain although did they have tenderness to palpation. Most of the women were seen in within 24 hours of the assault and would be expected to have less inflammation present and thus less pain. The women may not realize they have an injury until it is palpated. There was no information on whether they later feel pain as injuries heal however.

Genital injuries most often affected the posterior fourchette, hymen and anus and most often were lacerations or soft tissue injuries. This is consistent with the relatively fragile nature of the genital tissues. Tearing of tissue, redness or swelling would be anticipated. Nongenital injuries most often affected the head, neck, torso and lower versus upper legs and were most likely to be bruises or abrasions.

Factors Affecting Rates of Injury

The type of examiner had a significant effect on the rates of injury reported. SANEs reported genital injuries at rates twice as high as both Emergency physicians and sexual assault physicians although there was no difference in the nongenital injury rates. The studies reporting exclusive categories of injury revealed examinations done by SANEs reported three times the rate of genital injury compared to studies using Emergency physicians. In contrast, Emergency physician studies had rates of nongenital injury twice as high as the studies involving SANEs. Differences in the clinical backgrounds of each professional group may help explain these findings. SANEs come from a variety of backgrounds such as community health, obstetrics and trauma units.

They do not always have the background and expertise in trauma assessment that an Emergency physician would possess.

Experience does not explain the difference between sexual assault physicians and SANEs however. Genital injury rates were lower among medical residents with more experience [16] but it is anticipated that SANEs and sexual assault physicians would have seen similar numbers of cases. The number of cases seen or years of experience is not reported for either the SANEs or the one sexual assault physician for comparison.[15] The difference may be related to the absence of visualization adjuncts among the physician studies. All of the studies reporting toluidine or colposcopy with magnification for genital injury visualization involved SANEs. The clinical significance of an increased ability to visualize genital injuries has yet to be determined however, given that the majority of the genital injuries were of a minor nature.

The setting in which women are examined and the timing of their examination also resulted in different injury rates. The rates of both genital and nongenital injury were lower for women examined within 72 hours or more. It is not clear if this is because there were fewer injuries or because the injuries were likely to have healed by then. Differences in injuries between health care units and police setting warrant further investigation. The impact of seeing women in health care settings versus settings with police present is still unclear. Higher rates of physical, nongenital injury or both genital and nongenital injury were found among women who reported to police while there was no difference in rates of genital injuries with reporting practices. This may be due to a number of factors such as the increased visibility of nongenital injuries leading women to report, perceptions that the sexual assault is "valid" if there are visible injuries, or a reflection of the force required to inflict nongenital injuries.

The use of different measures of severity, coercion, and terminology for injuries or risk factors all contributed to variability in injury rates. For instance, it has been shown that nurses and physicians may classify the same injuries differently, calling them either abrasions or lacerations.[15] Differences such as these would affect severity indices. There also needs to be consistency in deciding to include or exclude findings such as redness or swelling from injury counts.

Influence of Risk Factors on Injury Outcomes

Biographic Risk Factors

The impact of the various biographic risk factors was not consistent between types of injuries. Nongenital injury rates were higher among all adult women compared to adolescents, especially if 50 years or older. Genital injury was greatest at either end of the age spectrum, with young women and mature women having greater rates. These findings suggest interaction with other factors such as changes in tissue elasticity with age, increased risk of being in abusive relationships as an adult, or other mechanisms through which nongenital and genital injury may result. A lack of prior sexual experience was associated with higher injury rates but not among adolescents as expected. Young adult women had slightly higher rates of genital injury if they had no history of prior sexual experience compared to younger or older women. The reasons for this finding are unclear.

Higher rates of nongenital injury were found among White and Aboriginal women while White and Black women had higher rates of genital injury. Differences in nongenital injury among Aboriginal women may be related to sociocultural issues such as housing, income, substance use, or domestic violence. Aboriginal women have significantly higher Emergency visits for intentional physical violence than any other racial group in Alberta[83] and are four to five times more likely to die from interpersonal violence.[84]

Nongenital injury rates were higher if alcohol or drugs had been used but the rates of genital injuries were the same regardless of substance use. There are difficulties in attempting to compare number of drinks or types of substances between women. There are variations in the rate at which different women metabolize substances and they may not experience the same degree of impairment with similar amounts of the same substances. Alternatively, a few studies reported injuries in relation to various levels of intoxication. There were more women with nongenital injuries if they were mildly intoxicated versus not intoxicated at all. If women were unconscious or markedly intoxicated they had fewer genital injuries than if they were awake or less intoxicated. This may be in part due to the relationship between resistance and aggression. As women become more intoxicated they have been found to use less resistance and therefore less aggression is required by the assailant.[85] Women who are assaulted are more likely to have been assaulted as children and be heavy drinkers.[86] The assailants were also found by these researchers to have been drinking heavily with the women, and to have aggression triggered by perceptions of women who drink.

There was very little research on psychiatric disorders and injury. Elderly women were found to be more likely to have vulnerabilities such as psychiatric disorders and cognitive disabilities compared to younger women in the same study but physical injury was equally likely for all age groups.[49] The differences may have been more evident if the researchers had examined genital and nongenital injury separately. There were higher rates of nongenital injuries in the few studies reviewed if there were psychiatric disorders present such as posttraumatic stress disorder and major depression. There was no difference in the rates of genital injuries. Combining the two categories of injuries would be likely to obscure differences if these findings are consistent in the literature.

There were a number of areas of potential interaction between the biographic factors that may influence injury rates. For instance, the use of physical resistance and the relationship of the assailant are likely to change with age. Rates of nongenital injuries were greater in adult and older women and have been associated with assaults by intimate partners.[87] Intimate partners have also been associated with the use of greater physical force.[12,50] Differences in physical maturity result in differences in tissue resiliency and elasticity if force or resistance were to be used. Factors such as estrogen levels, prior sexual experience, and health conditions all may play a role. Similarly, the rates of healing and influences on healing for genital and nongenital injuries differ and may interact with age.

Age may also interact with substance use and impaired consciousness. It is well recognized that alcohol metabolism differs between individuals and between age groups and that the number of drinks may not be the best indicator of capacity. The blood alcohol level may also not indicate capacity. The level of consciousness is perhaps the best indicator. Women had more nongenital injuries if they were mildly intoxicated and more genital injuries if they were conscious. These results may be due to the interaction with the ability to resist. Use of resistance techniques has been associated with decreased risk of completed penetration,[76] perhaps reducing genital injury risks. In contrast, use of resistance would be expected to increase nongenital injury as the assailant will require more physical aggression to complete the act. The increased rate of nongenital injuries in the presence of psychiatric disorders is also an indicator of vulnerability, of a more ongoing nature. The reason for higher rates of nongenital injuries with psychiatric disorders is not clear, but again may relate to either aggression or resistance.

Contextual Risk Factors

Only a few studies reported the assailants in categories beyond "known" and "unknown". There were higher rates and numbers of both genital and nongenital injury if the assailants were known to the women rather than strangers when all studies were examined using known and unknown categories. Nongenital injury rates were higher with intimate partners. A recently acquired friend might be expected to act differently in terms of physical and verbal aggression compared to an intimate partner. Almost a third of women presenting to Emergency after any form of assault had been victims of intimate partner violence.[88] Women who have been assaulted by intimate partners are significantly more likely to have experienced physical aggression such as beatings although there were no differences in physical injury reported.[89] A multivariate analysis of risk factors for physical injury with intimate partner violence included previous violence, fear for one's life, a partner who had been drinking and experiencing high levels of verbal aggression.[90] Further study is needed on the interaction of the assailant relationship, physical or verbal aggression and injury outcomes in the context of sexually assaulted women.

There was very little information with which to compare injuries by the privacy or location of the setting. Nongenital injury rates were high if the assault occurred in a vehicle but there were no data for genital injuries. This may reflect the limited space and irregular surfaces on which the women may be contacting during the assault, or perhaps an increased willingness of assailants to use force if they are less likely to be seen. Genital injuries occurred at higher rates if the assault occurred in someone's home compared to outdoors. The common theme is perhaps the privacy of the setting and risk of being interrupted or caught. Assailants are perhaps less likely to be observed or detected in a car or home than if they are outdoors, making it more likely that aggression can be used or penetration be completed.

Assault Risk Factors

There were no data on nongenital injuries sustained with the women's use of resistance, either physical or verbal although physical injury rates were higher if physical resistance was used. The use of physical resistance is expected to result in use of more restraint and force by the assailant, making increased physical or nongenital injury more likely.

Genital injuries were lower among women who were immobilized (e.g. by fear), followed by women who did not resist at all. The same mechanism is likely at work as with the decreased nongenital injuries when women were severely intoxicated or unconsciousness, although it does not explain why there were not fewer genital injuries in the latter.

Multiple assailants and use of more severe physical aggression (force) both demonstrated high rates of nongenital injuries. The differences in genital injury were negligible for both multiple assailants and use of severe force. Fewer women had genital injuries if a weapon was involved than no weapon, although there was a limited difference in nongenital injuries. The use of force, weapons and multiple assailants are all factors that result in intimidation or coercion of women and the interrelationships between these factors need to be studied.

More data is required regarding the interrelationships of various factors with penetration and aspects of penetration. There were no data on nongenital injuries with attempted or no penetration. The highest incidences of genital injury were among those with attempted penetration or no penetration compared to those with completed penetration, although numbers were small. This may reflect resistance, the effects of repeated blunt force or manipulation in the genital region, or force used during assailants' attempts at penetration. Again, the interrelationships between these factors warrant further examination including the objects used for penetration. As expected the highest rate of injury was with penile penetration of any sort, although only one study reported these results. There was a high incidence of injury (62%) with digital penetration as well.

Further research is also needed on injuries and positioning during the assault. All women were injured if made to stand during the sexual assault but very few women were involved. There was a high rate of injury among women who were either lying on their backs or who had to assume multiple positions. Further information is required regarding the use of lubrication as well. In some instances women had a chance to use a lubricant, such as when the intercourse started out as consensual and then became nonconsensual. There were small differences in the number of women injured with or without lubrication. It is often assumed that women have more injuries after sexual assault compared to consensual intercourse because of the lack of lubrication when in fact it may be due to other risk factors such as the blunt force from the penis stretching the genital tissues.

Limitations

There were only 43 studies that met the inclusion criteria for this review. Some of the anticipated risk factors (e.g.-socioeconomic status, disability) were either not studied at all, or had only one or two studies with data available. The small sample, therefore, limits the generalizability of the results. There were 140 studies that had to be excluded that could have contributed significantly to the review but they contained male or child data that could not be separated, or else the injury data were not reported in a format that could be analyzed. Attempts were made to increase the inclusion rate by contacting researchers for raw data but the data were not always available. The results of this analysis may have been different if these studies could have been included.

The heterogeneity of the studies limits the generalizability of the results as well as prevented the use of meta-analytic methods. More homogeneity is required in populations, settings, examination techniques and definitions of risk factors and injury outcomes before results can be meaningfully combined in a meta-analysis.

Implications

Practice

The heterogeneity and sometimes unclear results reinforce the need for sexual assault examiners to use standard terminology and definitions for injuries and standard techniques for visualization of injuries. Ultimately it is hoped that clinical practice can be improved if risk factors are more clearly understood. These standard definitions and techniques are required before further research can be conducted. In the short term, there are a number of risk factors that may be linked to risks for injury in many of the studies. Nurses can use this introductory information to counsel women who refuse physical examinations. Women should be advised that it is possible that if these circumstances are present they may have injuries present and be unaware. The presence of injury may in turn affect the nurse's decisions for prophylaxis or the woman's decision to report to police. Nurses should also be aware of the potential link between psychological injuries and physical injuries, incorporating this into their counseling and discharge assessments and recommendations.

Issues around the severity of injury are not clear in terms of health care consequences for women. There is a trend to move sexual assault centres for acutely assaulted women to a central agency staffed with police, social work and nurses and away from medical centres such as Emergency. This trend should be considered carefully until it is known how much additional care women require following a sexual assault that would need to be provided in a health care facility with potential for expanded services.

Education

Differences in ability to detect genital and nongenital injuries between SANEs and physicians suggests that need for some common education between these groups of professionals Some SANEs come from gynecology or obstetrics backgrounds rather than trauma backgrounds and may benefit from clinical practica involving nongenital injury identification. Conversely, Emergency physicians or residents may benefit from practica with SANEs or sexual assault physicians to improve genital injury identification. Alternatively they may consider using toluidine dye to visualize genital injuries. It is easy to use and affordable in comparison to the purchase and training associated with the use of colposcopy.

Community education of multidisciplinary professionals is important. The incidence of injury with digital penetration is one example. Police and health care staff have sometimes suggested that perhaps sexual assault examination or investigation is not needed "because it was only digital". The absence of injuries is also an area for education. It does not equate to a false allegation and there may be many factors to explain why there were no physical injuries.

Research

While it is possible to obtain prospective cohorts, experimental designs are unlikely with this sensitive population. Further research is required with attention to reducing or controlling for sources of heterogeneity until the effects of the risk factors and their interactions are more clearly understood. Consensus needs to be reached between researchers as to what findings will be considered "injuries" (e.g. redness or swelling). It is clear from this review that different mechanisms may be influential in genital injuries compared to nongenital injuries so these should be reported separately. Severity of injury, number of sites of injury, types of injuries (e.g. abrasions, lacerations) and locations of injury for each outcome should be explored in multivariate analyses to help understand the effects and interactions of the risk factors on genital and nongenital injury.

The research population needs to be more homogeneous or the data need to be reported separately. Examples include age groups (adolescent, adult and elderly) and gender. The visualization methods and personnel used to detect the injuries should be clearly described in the study reports to allow comparison. These include use of any visualization adjuncts, sexual assault training received by examiners, types of professionals conducting the examination, and the experience levels of examiners with sexually assaulted women. Results of studies should be reported in a variety of formats. There were another 17 studies that could have been included but the data were in the form of odds ratios or beta effects rather than frequencies and could not be integrated. The use of indexes of severity and coercion may be useful to explore and report on a more widespread basis to allow comparisons between settings.

The clinical and legal significance of injuries warrants further examination. Although SANEs in this review detected more genital injuries especially if visualization adjuncts are used the significance of these is under debate. Further research is required to compare these microscopic findings with those found in women after consensual sex. Ultimately the role of genital and nongenital injuries in the development of sexually transmitted infections and psychological consequences needs to be explored as well.

Conclusion

The results of the review indicate that there are many differences in the rates of genital and nongenital injury and risk factors that influence them. This suggests that genital and nongenital injuries need to be studied as distinct groups rather than an all encompassing group with "physical injury". There are differential effects of selected risk factors on these injuries and many areas in which interaction between risk factors is likely. As the role of sexual assault examiners expands there is a need to develop more standardized practices, education and research to better meet the needs of sexually assaulted women.

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CHAPTER 3: MODELING WOMEN'S RISKS OF INJURIES FROM SEXUAL ASSAULT

A staggering 39% of Canadian women are thought to have been sexually assaulted at least once in their lifetime (Federal/Provincial/Territorial Ministers Responsible for the Status of Women, 2002). Many of these women will have sustained genital or nongenital injuries as a result of the assault. If they have injuries, women are at greater risk for transmission of sexually transmitted infections during the assault (Health Canada, 1998) as well as significant long term complications such as posttraumatic stress (Acierno, Resnick, Kilpatrick, Saunders, & Best, 1999; Bownes, O'Gorman, & Sayers, 1991a) and its associated chronic health problems, depression and suicide (Foa & Street, 2001).

In an early study, Cartwright (1987) reported that a median of 30% of women had neither genital or nongenital injuries, a median of 19% of women had only genital injuries, a median of 26% had only nongenital injuries, and a median of 21% and both genital and nongenital injuries. Despite the majority of women experiencing injury, only a small number of women experience pain or bleeding with their injuries (Rambow, Adkinson, Frost, & Peterson, 1992). Without pain or bleeding women who are not examined may underestimate the number of injuries they have, and may therefore either not seek health care or may refuse a physical exam when they do contact health professionals.

There are legal consequences associated with the presence of injuries. Police are more likely to believe that an assault is "real" and to lay charges in the presence of injuries (McGregor, Le, Marion, & Wiebe, 1999). In addition, women are more than three times more likely to report to police if injuries exist (Du Mont, Miller, & Myhr, 2003). Once a case is in court, sexual assault examiners are often asked to testify in court regarding the presence or absence of injuries and their implications. A better understanding of reasons for the presence or absence of injuries is required given the consequences of this information.

An improved understanding of the factors that contribute most to genital or nongenital injuries is vital to nurses caring for women after sexual assault. Nurses in the community or in sexual assault clinics may be better equipped to identify those women more likely to have injuries if they refuse an examination once the relevant details of their background or the context and nature of the assault were known. This information would then help in determining the most appropriate interventions to prevent both short and long term consequences of injuries. Strategies may be explored to reduce injuries or their consequences.

Background

Very few studies have included an in-depth examination of risk factors in relation to injury after sexual assault. Only 43 studies between 1960 and 2006 were identified in a previous systematic review (Carter-Snell, 2007). The methods of analysis, the injury outcomes, measurement issues, differences in definition, and risk factors for injury are summarized in the following paragraphs.

Methods of Analysis

The methods of analysis were predominantly univariate in nature. Associations between variables may be due to indirect and unknown causes. There was very little multivariate research available on injury with sexual assault and it was predominantly using stepwise multiple regression. Common practice with multiple regression is to limit selection of predictor variables for the equation only if they were significantly associated in preceding univariate tests. This method may have led to inadvertent exclusion of factors that would have been significant if they were examined in interaction with another factor. Newer techniques such as structural equation modeling offer an advantage over multiple regression by allowing simultaneous examination of interactions rather than one by one. This has been shown to result in improved explanation of the outcomes (Kline & Klammer, 2001; Pfeiffer & Morris, 1994).

Injury Outcomes

The injury outcomes used in the sexual assault literature varied widely. The location of injury reported ranged from the presence of "physical injury" to the presence of genital and/or nongenital (body) injury. The rates of each type of injury were not the same within any of the studies. Higher rates of genital injury were found among women who also had nongenital injury (Slaughter, Brown, Crowley, & Peck, 1997). This suggests that although the two types of injury are different, that there may be common mechanisms linking the two.

In addition to the type of injury, definitions of injury were not consistent. Some authors considered redness, swelling or tenderness to be indicators of injury while others did not. Some teams regarded lacerations and penetrating injury as equivalent, although one is from blunt force and the other from a weapon or sharp object. Soft tissue injury also varied in definition between researchers with some including abrasions and lacerations, while others limited the definition of soft tissue injury to swelling and bruising. The definitions of injury therefore affected both the numbers and severity of injury reported in the literature, and thus complicate comparisons.

Measurement Issues

The level of measurement is also a concern in the literature on risks for injury. Most researchers reported injuries as present or absent and the proportion of women in each category. Presence of injury does not reflect either the number or severity of injuries. Only a few researchers reported the number of injuries or sites of injuries (Anderson, McClain, & Riviello, 2006; Biggs, Stermac, & Divinsky, 1998; Jones, Rossman, Hartman, & Alexander, 2003; Jones, Rossman, Wynn, Dunnuck, & Schwartz, 2003; Slaughter et al., 1997). Number of injuries, however, cannot be assumed to equal severity (Biggs et al., 1998); (Jones et al., 2003) (Jones, Wynn, Kroeze, Dunnuck, & Rossman, 2004; Slaughter et al., 1997). For instance, one woman may have four bruises while another may have one major internal injury such as head trauma. A severity of injury index has been developed and used in a few Canadian studies of sexual assault (Del Bove, Stermac, & Bainbridge, 2005; Dunlap, Brazeau, Stermac, & Addison, 2004; Stermac, Del Bove, Brazeau, & Bainbridge, 2006; Stermac, Del Bove, & Addison, 2001; Stermac, Du Mont, & Kalemba, 1995). Weights are assigned to different types of injuries in order of perceived severity, with the ranking of weights validated by a group of 10 experts. For this study it was thought that a measure of severity would likely be a better reflection of intensity of violence and mechanisms of injury associated with the selected risk factors.

Risk Factors

There is minimal research available on risks for injury and injury outcomes, with some reported risk factors not having been studied at all. The risk factors for this study were therefore drawn from a combination of three sources: results of the previous systematic review; clinical observations; and descriptive literature. The risk factors were then grouped into three major categories: biographic; contextual; and assault.

Biographic Risk Factors

The biographic factors were mainly inherent to the individual or antecedent to the assault. Genital injury was higher among both younger and older women (Crane, 2005; Sugar, Fine, & Eckert, 2004; Sugar et al., 2004). Lack of prior sexual experience has been linked to higher rates of genital injury. Across the studies reviewed this finding occurred predominantly in women aged 15 to 29 years of age (Adams & Knudson, 1996; Biggs et al., 1998; Hilden, Schei, & Sidenius, 2005; Rossman, Jones, Wynn, & Nelson-Horan, 2000; Sugar et al., 2004; White & McLean, 2006). Nongenital injury was higher if women were older than 40 years of age (Crane, 2005; Sugar et al., 2004). Elderly women were also more likely to require ambulance involvement for their injuries (Del Bove et al., 2005).

The age of women may introduce other risk factors for nongenital injury simultaneously. For instance, older women were found to have more psychiatric and cognitive disabilities than younger women (Del Bove et al., 2005). High rates of nongenital injury were found if women had psychiatric disorders such as posttraumatic stress disorder or depression (Bownes, O'Gorman, & Sayers, 1991b).

There is limited substantive work on relative risks for injury after sexual assault across Canadian racial groups. Those women who were from White or Black racial origins had greater genital injury than other races (Cartwright, 1987; Crane, 2005; Sachs & Chu, 2002; Sommers et al., 2006). White and Aboriginal women had the highest rates of nongenital injury among racial groups (Crane, 2005), although there were very few

Aboriginals in the study group. Aboriginal women rather than Black women are one of Canada's largest minority groups. Related literature describes Canadian Aboriginals as being at risk for more severe forms of violence than non-Aboriginal women (Amnesty International, 2004) and facing seven times higher rates of Emergency visits for intentionally inflicted violence than other races (Alberta Centre for Injury Control & Research , 2005). This information would suggest that Aboriginal women may also be at risk for greater injury after sexual assault than other races in Canada.

Higher socioeconomic status was linked to higher rates of genital injury with more women injured if they were employed versus on welfare (Hilden et al., 2005). Homelessness was linked to assault by strangers in a multiple regression analysis of assault characteristics (Stermac et al., 2006). There were increased nongenital injuries found if women were mildly intoxicated (Sachs & Chu, 2002) while there were decreased genital injury rates if women were unconscious or unaware during the assault (Hilden et al., 2005; Sachs & Chu, 2002).

There were no data on the rate of genital or nongenital injuries among disabled versus non-disabled women in the studies reviewed. It has been observed, however, that women lacking cognitive skills or physical abilities report being less able to resist assaults.

Contextual Risk Factors

The contextual factors include those elements in the environment or circumstances that may influence injury. Higher rates of both genital and nongenital injuries were reported in most of the studies if the assailant was well known or intimate with the woman compared to assaults by strangers (Bownes et al., 1991b; Cartwright, 1987; Crane, 2005; Hilden et al., 2005; Read, Kufera, Jackson, & Dischinger, 2005; Sachs & Chu, 2002; Slaughter et al., 1997; Stermac et al., 2006; Stermac et al., 1995). It may be assumed that the intimate partner used more physical aggression, but that was not consistently found. Strangers used more aggression in some studies of adolescent assaults (Jones et al., 2004) and adults (Stermac et al., 1995) . Other studies found higher levels of aggression if the assailant was an intimate partner (Stermac, Dumont, & Dunn, 1998; Stermac et al., 2001).

Research on the role of settings on injury is limited. One study reported greater genital injury if women were assaulted in someone's home compared to a public place (Hilden et al., 2005). Nongenital injuries were found in 70% of women who were assaulted in vehicles but no comparison to other settings was noted (Sugar et al., 2004).

Assault Risk Factors

The assault factors include factors specific to contact with the assailant. Physical aggression was highest among intimate partners in many of the studies. Genital injury was found to be more common in women who used verbal or physical resistance strategies and less common in those immobilized by fear or who used no resistance (Sachs & Chu, 2002). High rates of genital injury were found with anal penetration compared to other sites (Sachs & Chu, 2002), or with penetration by a penis or fingers (Rossman, Jones, Dunnuck, Wynn, & Bermingham, 2004; Slaughter et al., 1997). Nongenital injury was also high among women who reported oral or anal penile penetration (Sugar et al., 2004). Attempted penetration was also linked to high rates of genital injury (Slaughter et al., 1997).

The presence of a weapon during the assault has been linked to lower rates of genital injury but higher rates of nongenital injury (Crane, 2005; Sugar et al., 2004). The highest rates of nongenital injury were found if a knife or club was present while the lowest rates were associated with the presence of a gun (Cartwright, 1987).

Nongenital injury was found to be high if there were multiple assailants compared to single assailants (Crane, 2005; Sugar et al., 2004), although no difference in either genital or nongenital injury was found with multiple assailants in an earlier study (Cartwright, 1987).

Physical aggression, including use of force, restraints and attempted strangulation are associated with high rates of nongenital injury (Hilden et al., 2005; Sachs & Chu, 2002) although it isn't clear whether strangers or intimate partners used more aggression. Verbal aggression and coercion have also been shown to result in greater physical injury (Forbes, Adams-Curtis, Pakalka, & White, 2006). Weapons or physical coercion are more likely to be used with adults, compared to adolescents, perhaps affecting the lower rates of nongenital injury in adolescents. In a study of adolescents, strangers were more likely to use weapons or physical force than were known assailants (Jones et al., 2004).

Conceptual Model

The preceding studies were used to construct the conceptual model tested in this study. The initial model included four exogenous concepts, all biographic factors. These included level of consciousness, maturity (age), sociocultural (race and income), and vulnerability (psychiatric disorder and disability). These concepts were considered to precede the endogenous (dependent) variables and it was recognized that there are likely other factors acting on these concepts (e.g. substance use resulting in altered consciousness) but no attempt was made to explain their source or any influences on them.

The contextual and assault factors were all endogenous, receiving influences from the biographic indicators. Genital injury was hypothesized to be directly influenced by physical maturity. The effects of low estrogen in adolescent and elderly populations and resulting differences in genital tissue resiliency may explain differences in genital injury in these age groups. The main influence on genital injury was expected to come from the penetration site, which would be a result of physical aggression. In turn, physical aggression would be increased by verbal resistance and physical resistance. It was anticipated that women who were more alert or who were more mature would use more resistance strategies and therefore perhaps face more aggression and penetration. Use of verbal resistance was also thought to directly affect the assailant's choice of penetration site, perhaps as a means of control or humiliation. For the same reason, it was anticipated that the sites associated with higher injuries (e.g. anal, more than one site) would be used by more intimate assailants and in more private settings. Weapons were thought to decrease the women's physical resistance and therefore increase the probability of completed penetration of at least one site, as was verbal aggression and physical aggression.

Nongenital injury was hypothesized to be a result primarily of physical aggression. Aggression was expected to increase when women used more resistance strategies. The use of these strategies would be more likely if women were more conscious. Women who were more mature were anticipated to be less vulnerable and more likely to use resistance strategies. Weapon use and multiple assailants were also thought to lead to increased physical aggression. The privacy of the setting was thought to increase the risk of physical aggression both directly and through women's increased use of resistance.

There has been a relationship identified between genital and nongenital injury. It was hypothesized that this was due to the use of increased physical resistance following penetration which would then lead to physical aggression and therefore nongenital injury. The errors between consciousness and physical maturity were specified to co-vary, based on the assumption that the sources of these errors were common.

Purpose of the Study

Although researchers have identified a group of key risk factors for injury associated with sexual assault, there is very little understanding of the relative contribution of each factor to injuries or how the factors interrelate to result in either genital or nongenital injury. None of the studies of risk for genital and nongenital injury related to sexual assault fully considered the potential for interactions between the factors identified above.

The purpose of this study was to test the conceptual model described, using a data set comprised of information collected by nurses with specialized education and experience in sexual assault assessment and interventions. Specific research questions included the following:

1. What are the influences of selected risk factors (biographic, contextual and assault) on nongenital and genital injury outcomes?
2. What are the relationships between the selected risk factors leading to injury outcomes (genital and nongenital) and the injury outcomes themselves?

Methods

Sample

Following ethical approval by the Health Research Ethics Board, University of Alberta, the sample data were obtained from the clinical database of an urban sexual assault response team (SART). The sample was comprised of females at least 14 years of age who were assaulted within the past seven days between April 2002 and May 2007. Cases were excluded if they were male, if they refused both the physical and genital examination, if they were "incomplete" visits (SART went to see the client but they were too unstable or too intoxicated to consent at that time), or if the case was only a consult (SART does not go to see the client but may be contacted by health staff or the police). All data were collected in an Emergency Department by specially educated sexual assault nurse examiners who were part of an urban sexual assault response team (SART). SART nurses use a 470 nm ultraviolet light to look for stains and deep bruising, and apply toluidine 1% blue dye to genital regions to visualize injuries. SART nurse documentation and assessment is supervised for at least two to three months after their theoretical preparation. Their practice and documentation of findings are then monitored at approximately six months and again at least yearly.

It was hoped that at least 1000 women could be included in the study, in order to allow for deletion of cases in the analysis as well as deletion of those who did not meet the criteria. A minimum of 200 women would be required due to the complexity of the model although it has been recommended that there be 5 to 10 cases per estimated parameter in the model (Kelloway, 1998). There were 26 hypothesized relationships, suggesting a minimum of 260 women would be required, and approximately 500 if the sample were to be split in half for confirmatory testing. There were a total of 1303 cases available in the database at the time of extraction, and 1005 women were able to be included in the study. Reasons for exclusion of cases are summarized in Table 3-1.

Table 3-1.

Reasons for Exclusion from Study

Reason for Exclusion	**Number of Cases Excluded**
Missing both a genital or nongenital examination	127
Consult with health agency but no visit or exam	102
Went to see client but unable to consent to exam	50
Male client	19
Total excluded	298

Reliability of the data entry was verified using a random sample of 100 cases from the 1005 eligible cases. There were 191 elements entered into the database for each client. There was a mean error rate of 2.9% with a median of 2.6% (range 0 to 13.1%) for the 100 patients studied. There was no apparent pattern in the rates of error across the years included.

Measures

All of the indicators selected for this study were available from the SART database.

Injury Outcomes

The primary injury outcomes for the model were severity of genital injury and nongenital injury. Severity was determined by adapting the severity of injury index from the Canadian literature (Stermac et al., 2006) to include the following weights: tenderness (1); soft tissue injury including bruises and abrasions (2); lacerations (3); fractures and penetrating injuries (4); and internal injuries including head injuries (5). Pain was omitted from the original scale as this data was not routinely available for each woman. The key reason for this is because tenderness to palpation is considered a more objective and localized sign and may reflect underlying injury not yet visible such as deep bruising. In contrast, pain is recognized as more subjective and is a symptom rather than a finding like the other items. Abrasions were added to the soft tissue injury weight. Penetrating injuries were added to the fracture category as they were considered more severe. Reasons for this included the potential for deeper injury with stab or puncture wounds and that the need to have a weapon to inflict them implied greater seriousness. Head injury was the only form of internal injury routinely collected by SART. Separate scores were calculated for nongenital injury and for genital injury. The total numbers of each type of injury (genital and nongenital) were also collected to see if the model was comparable for both outcomes.

Biographic Factors

Maturity was indicated by each woman's age in years. Data on prior sexual experience is sensitive to collect for some women after sexual assault as they may fear judgement, or it may influence the court proceedings as to how much of their past history is revealed. Staff only collected information about sexual experiences within the last seven days as this can interfere with DNA testing from the assault. Further information about the woman's sexual experience is unnecessary for the examination other than if they have ever had a gynecological examination before. Some women did volunteer the information about prior sex however. The number of missing cases made this factor unreliable for use in the model.

Psychiatric disorder was coded as absent (0), possible if on antidepressants or antianxiety medications (1), present if there was a diagnosis of posttraumatic stress disorder, depression or generalized anxiety disorder (3) and severe if there were suicidal attempts (4). Disability was defined as the presence of either a cognitive disability (1) physical disability (2) or both (3).

There is very little information on injuries from sexual assault rather than physical assault among Aboriginal women. It was observed clinically that Aboriginal women appeared to have more severe injuries of any type compared to White women. A race category was therefore used to distinguish non-aboriginal women (0) from Aboriginal women (1). Women from lower socioeconomic groups appeared to have more severe injuries than more middle-class women. The mean income for females was identified by the income for their postal code. In cases where there was a postal code was absent, the mean income for the hospital region they attended was used.

Consciousness level at the time of the assault was coded as unconscious (0), drowsy (1) and alert (2). Alcohol and drug ingestion data were available but since incapacitation levels vary with individuals we thought it more important to use the result of the ingestion – the level of consciousness at the time of the assault.

Contextual Risk Factors

Contextual risk factors included in the model were level of intimacy and the privacy of the setting. Level of intimacy was coded as uncertain of identity (0), stranger (1), acquaintance less than 24 hours (2), acquaintance known more than 24 hours (3), family member (4), and past or present intimate partner (5). The privacy of the setting was coded as a public place (1), outdoors (2), multiple locations (3), vehicle (4), or a home (5).

Assault factors

Aggression data were available for both physical and verbal aggression and it was thought there may be differing influences on genital and nongenital injury if kept separate. Verbal aggression was coded as one of the following: none (0); uncertain (1); coercion (2); insults or yelling (3); or threats to life (4). A weighted score for physical aggression was used, adapted from a coercion scale developed by Canadian researchers (Del Bove et al., 2005; Dunlap et al., 2004; Stermac et al., 2006; Stermac et al., 2001; Stermac et al., 1995). A total physical aggression score was determined by adding the weights for each of the following acts of aggression used by the assailant: drug facilitated assault suspected (1); restrained (2); hit, slapped, punched or kicked (3); and attempted strangulation (4). Verbal aggression and unconsciousness were omitted from the original coercion index, as these concepts were analyzed separately. Attempted strangulation was added to the scale for this study.

Resistance was also separated into verbal and physical resistance indicators. Verbal resistance included none (0), client uncertain (1), froze or immobilized and unable to speak (2), client asked to stop (3), and yelled or screamed (4). Acts of physical resistance were coded as one of the following: none (0); uncertain (1); frozen-immobilized and unable to move (2); or fought/ran (3).

The site of penetration was coded in ascending order of the regions associated with the greatest genital injury: uncertain of sites (1); attempted penetration only, any site (2); oral penetration (3); vaginal penetration (4); anal penetration (5); penetration of more than one site excluding anal (6); or penetration of more than one site including anal (7). The object used for penetration was ordered in terms of the injury rates associated with each object in ascending order: external manipulation (1); foreign body (2); digital penetration (3); penis (4); or more than one object (5).

Analyses

The conceptual model was tested using structural equation modeling in LISREL version 8.3 with maximum likelihood estimation. The measurement error was set at 10% for all indicators due to the subjective nature of the indicators and to allow for error in interpreting subtle injuries between examiners. All indicators were treated as continuous variables rather than using polychoric correlations. It is unknown if the effects of altering a non-normal distribution with polychoric or polyserial correlations is worse than with using an ordinary correlation coefficient, and the conversion may make results of the model dependent on the data rather than the effects of the model (Hayduk, 1987). Modifications were made based on modification indices only if they were consistent with theory or substantively logical. Reciprocal influences were avoided where possible.

It was anticipated that some of the indicators may have to be excluded from the model if there were too many missing values (>20%) or if the indicator had extreme kurtosis or skew (non-normal distribution). Multiple regression tests were planned and conducted for these excluded indicators using forward entry to examine the influences of these indicators on genital and non-genital injury. SPSS 14.0 was used to conduct the analyses. The significance level was set at 0.01 to adjust for the risks of Type I error with multiple tests.

Results

Initial Estimation

Convergence could not be obtained with the initial conceptual model due to the presence of a "not positive definite matrix". Key causes of a not positive definite matrix include: non-normal distributions with kurtosis or skewness more than an absolute value of 3.0; correlations between indicators of more than 0.70; and indicators with more than 20% missing values (Hayduk, 1987; Rigdon, 1997; Wothke, 1993). Six variables were excluded for these reasons:

- Aboriginal status – 30% missing data
- Average income – 38% missing data
- Psychiatric disorder – 45.9% missing data
- Disability- kurtosis of 22.6
- Number of assailants – skewness 6.3 and kurtosis 70.5
- Object used to penetrate – correlation with penetration 0.78

Of note, the outcome indicators of injury (severity and total numbers) all had significant kurtosis and skewness with some extreme outliers (greater than two standard deviations), but given the purpose of the study, these items were kept. The inclusion of weapon use had been included both as a second indicator of physical aggression and as a concept on its own but difficulties with the model converging remained and it was removed. Lastly, due to the potential for error in the measurement and the exploratory nature of the model development, it was decided to free the covariance between the errors on the endogenous concepts rather than fixing them as planned. These changes reduced the sample size to 485.

The final sample consisted of 485 women with a mean age of 24.4 years (SD 9.8) with a median of 21 and a mode of 18 years. The women presented within an average of 21.7 hours after the assault (SD 32.3). Detailed data comparing the full sample and final sample are found in Appendix B. There were 446 women with nongenital injury (91.2%) and 370 with genital injury (76.2%). Table 3-2 shows the breakdown of injuries as well as rates of refusal for examinations. All women who refused one type of exam were excluded from the final sample.

Table 3-2

Injury Types and Examination Results for Samples

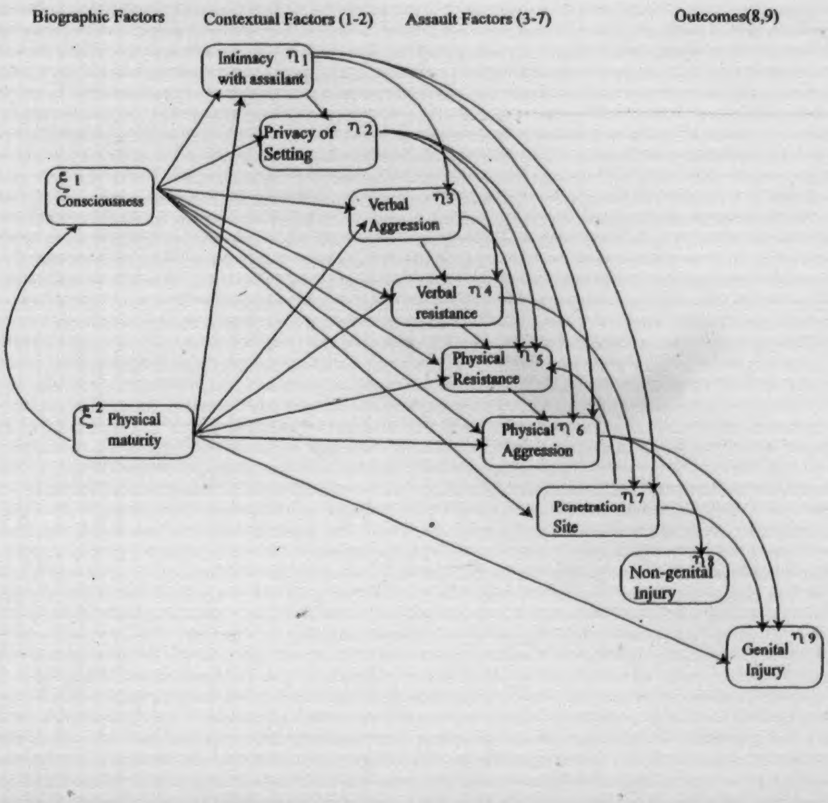
Injury Description	**Full Sample N=1005 n (%)**	**SEM Sample N=485 n(%)**
No nongenital injuries, refused genital exam	3 (0.3)	--
Nongenital injuries, refused genital exam	31 (3.1)	--
No genital injuries, refused nongenital exam,	14 (1.4)	--
Genital injuries, refused nongenital exam	26 (2.6)	--
Neither genital or nongenital injuries	32 (3.2)	14 (2.9)
Genital injuries only	57 (5.7)	25 (5.2)
Nongenital injuries only	228 (22.7)	115 (23.7)
Both genital and nongenital injuries	614 (61.1)	331 (68.2)

Nongenital injuries were more common than genital injuries in both samples. Most women had both genital and nongenital injuries, with minimal difference between the samples. Any women who refused either a genital or nongenital exam would have been omitted during listwise deletion in the SEM sample.

There were concerns that the listwise reduction of the sample size to less than half may have altered the characteristics of the final sample in comparison to the full sample. The final sample characteristics were compared with the full sample using Cochran's average variability technique (Sousa, Zauszniewski, & Musil, 2004). The expected mean or frequency for each variable was calculated along with a confidence interval for the estimate based on the sample sizes and variability of the larger population. The final SEM sample had less women than expected for each of the following indicators based on frequencies in the full sample: Aboriginals; unconscious women; situations where women did not know who assaulted them or the circumstances; outdoor assaults; and oral penetration. There were more women assaulted with a foreign body (2 vs. 4) and more with attempted penetration (4 vs 6). All other model indicators were within the 95% confidence interval for its expected value, as were the excluded indicators and the number of hours since the sexual assault. The final sample obtained after listwise deletion was therefore considered comparable to the full dataset

The final initial model was developed after exclusion of the preceding indicators and concepts. It is shown in Figure 3-1.

Figure 3-1. *Initial Conceptual Model*


Biographic Factors
Contextual Factors (1-2)
Assault Factors (3-7)
Outcomes(8,9)
Intimacy with assailant η_1
Privacy of Setting η_2
ξ_1 Consciousness
Verbal Aggression η_3
Verbal resistance η_4
Physical Resistance η_5
ξ_2 Physical maturity
Physical Aggression η_6
Penetration Site η_7
Non-genital Injury η_8
Genital Injury η_9

The model consisted of two exogenous concepts (consciousness and maturity) and nine endogenous concepts (intimacy, privacy of setting, verbal aggression, verbal resistance, physical resistance, physical aggression, penetration, nongenital injury severity, and genital injury severity). There were single indicators for each concept and these were fixed at 1.0. The $\chi 2$ was 41.2 (2 df, p=0.01), RMSEA 0.26, and GFI 0.98.

The variance-covariance matrix for the initial model is shown in Table 3-3.

Table 3-3

Variance-covariance Matrix for Initial Model with Severity of Injury

N=485	Intimacy	Privacy	Aggression-verbal	Resistance-verbal	Resistance-physical	Aggression-physical	Penetration site	Nongenital Severity	Genital Severity	Conscious-ness	Age
Intimacy	*1.71*										
Privacy of setting	0.81	*3.43*									
Aggress-ion-verbal	0.05	-0.09	*1.70*								
Resist-verbal	0.44	0.37	0.21	*1.60*							
Resist-physical	0.15	0.05	0.28	0.44	*1.42*						
Aggress-ion-phys	0.11	-0.31	1.42	0.87	0.88	*5.89*					
Penetrat-ion site	0.78	0.69	0.38	0.81	-0.06	1.20	*4.10*				
Nongen-ital Injury	-1.43	-3.05	6.54	0.01	3.30	13.7	-1.55	*465.8*			
Genital Injury	0.38	-0.49	0.59	0.07	0.18	1.36	1.59	0.82	*28.4*		
Conscious level	0.38	0.22	0.22	0.48	0.08	0.77	1.12	-0.09	0.44	*0.71*	
Age	0.75	1.24	3.10	0.67	0.37	4.91	1.65	26.54	-0.28	0.62	*95.9*

Model Modification and Results

There were limited data for some of the concepts specified in the initial model and how they might interrelate. This lack of specificity led to the need to initially overidentify the model and subsequently delete 13 parameters. While it is usually best to constrain the influences of a model in confirmatory testing, this was an exploratory model. Under-identification would have caused the model to fail (Byrne, 1998).

There were 13 effects initially hypothesized that were not significant at the 0.05 level and were subsequently removed. In addition the errors between consciousness and maturity were not significantly related. All remaining influences were significant at the 0.05 level and most were significant at the 0.01 level. The unstandardized direct effects are shown in Table 3-4.

Table 3-4.

Unstandardized Direct Effects in Final Model with Severity of Injury

Factor Receiving Effect	Consciousness	Maturity	Intimacy	Privacy	Verbal Aggression	Verbal Resistance	Physical Resistance	Physical Aggression	Penetration	Nongenital Injuiy Total
Intimacy	0.56	ns								
Privacy of Setting	ns	ns	0.50							
Verbal Aggression	0.29	0.03	ns							0.01 (new)
Verbal Resistance	0.68	ns		0.07*	ns					
Physical Resistance	ns	ns		ns	0.15	0.32			-0.10	
Physical Aggression	1.02	0.03	-0.19	-0.12*	0.56		0.49			
Penetration Site	1.59		ns	0.10* (new)		ns		ns		
Nongenital Injury								2.31	-1.13* (new)	
Genital Injury		ns						ns	0.41	

* significant at p<0.05, remainder significant at p<0.01

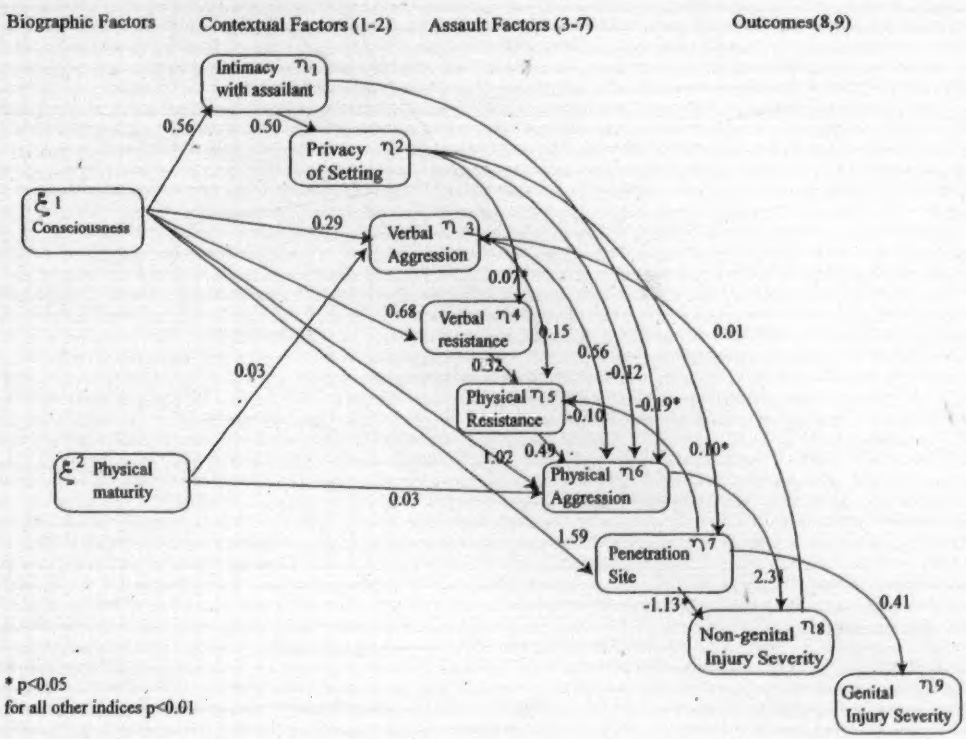
The only significant direct effect on genital injury was from the site of penetration. Penetration received the strongest positive influence from the women's level of consciousness. If they were more awake, they were more likely to have more high risk sites of penetration (e.g. anus) or more sites of penetration. There was also an indirect effect of being more awake during an assault by an assailant with whom one had a more intimate relationship. Better known assailants were more likely to choose more private settings, which is in turn linked to more high risk sites of penetration.

Three new significant effects were added based on the modification indices: penetration site from privacy of setting; nongenital injury from penetration; and verbal aggression from nongenital injury. After the three modifications, the $\chi 2$ was 30.3 (33 df, p=0.6), a root mean square error of approximation (RMSEA) of 0.0, and a goodness of fit index (GFI) of 0.99. The parsimony of the GFI was 0.49 after non-significant effects were removed (increased from 0.34). Sensitivity analyses were then conducted using different error variances. It was possible to reduce the error variance to 0.05 from 0.10 and to retain a good fit with the model. Below 0.05, however, the adjusted GFI and RMSEA both began to rise.

The final model is shown in Figure 3-2 along with the unstandardized coefficients for each effect. The final model was based on an error variance of 0.05 had a $\chi 2$ of 33.4 (33 df, p=0.4), RMSEA 0.0, and GFI 0.99. The latent concepts in the model accounted for 95% of the variance in the indicators for both the endogenous and exogenous concepts. The Bentler-Bonett normed fit index (NFI) was 0.96 and the standardized root mean square residual was 0.03, both indicating a good fitting model (Ullman, 2007).

The power of the final sample was estimated using tables based on the root mean square error of approximation of 0 and 33 degrees of freedom (Hancock & Freeman, 2001). It was estimated to be between 0.93 and 0.98.

Figure 3-2. *Final Fitted Model with Severity of Injury*



* $p<0.05$
for all other indices $p<0.01$

Genital and nongenital injury were linked through the penetration site and the woman's level of consciousness. Attempted penetration was associated with increased physical resistance and more aggression in comparison to completed penetration. If women were more awake, they were more likely to use verbal resistance, which influenced physical resistance and resulting physical aggression. At the same time, they were more likely to have penetration of the anus or multiple sites and therefore more genital injury. It had been hypothesized that the penetration would lead to more physical resistance. In fact, there was a mild inverse relationship. The influence of physical resistance from penetration site was quite small in relation to the influence of other risk factors on physical resistance.

The strongest influence on nongenital injury was from the level of physical aggression. Higher levels of physical force resulted in more severe injury. Less intimate or familiar assailants were more likely to use higher levels of physical aggression. If they were less conscious, women were more likely to be assaulted by less intimate (more unknown) assailants. The site of penetration had a strong negative influence (-1.13) on nongenital injury, suggesting that if lower risk sites of penetration were used (external manipulation or attempted penetration) there was increased risk of nongenital injury. Conversely, less nongenital injury was likely if anal penetration or penetration of multiple sites occurred.

Relationships between Selected Risk Factors and Numbers of Injuries

The model was re-estimated using the total number of genital and nongenital injuries with the variance-covariance matrix in Table 3-5. It was unknown if the influence of the risk factors would be similar with total injuries and severity of injuries.

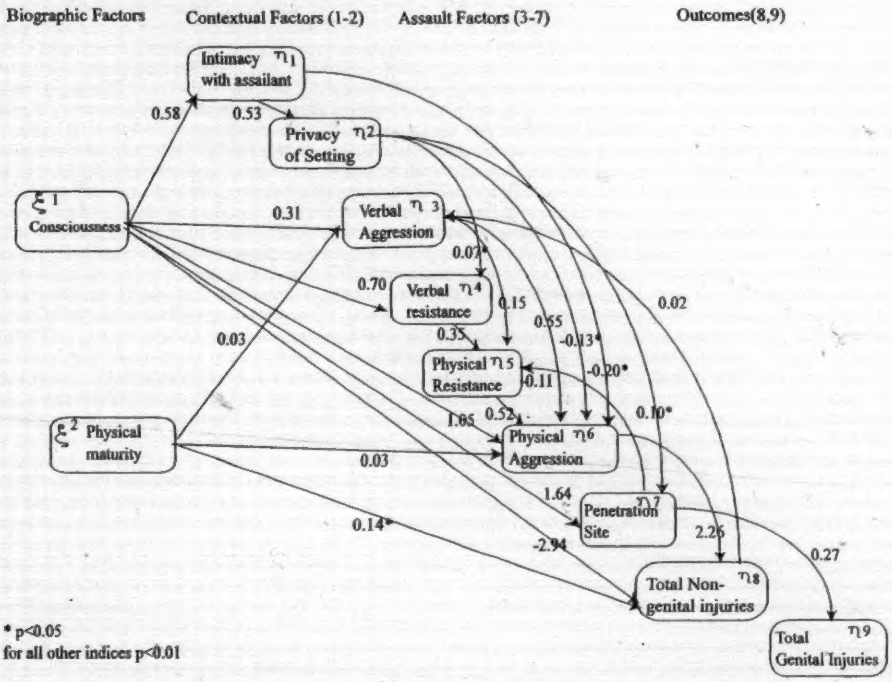
Table 3-5. Variance-covariance Matrix for Total Injuries

N=487	Intimacy	Privacy	Aggression-verbal	Resistance-verbal	Resistance-physical	Aggression-physical	Penetration site	Nongenital Injuries	Genital Injuries	Conscious-ness	Age
Intimacy	*1.71*										
Privacy of setting	0.81	*3.44*									
Aggression-verbal	0.05	-0.08	*1.70*								
Resistance-verbal	0.44	0.37	0.21	*1.60*							
Resistance-physical	0.15	0.05	0.28	0.44	*1.42*						
Aggression-physical	0.11	-0.30	1.42	0.86	0.88	*5.88*					
Penetration site	0.78	0.70	0.38	0.82	0.06	1.19	*4.10*				
Total Non-genital Injuries	-0.39	-3.14	4.91	0.50	2.64	11.52	-0.60	*170.1*			
Total Genital Injuries	0.25	-0.09	0.32	-0.03	0.06	0.63	1.01	0.94	*6.52*		
Consciousness	0.38	0.23	0.22	0.48	0.08	0.77	1.12	-0.14	0.28	*0.74*	
Age	0.73	1.00	0.65	0.65	0.29	4.79	1.49	21.42	0.46	0.63	*98.3*

The sample size increased to 487 as there were two women who had total nongenital injuries. The severity of injury could not be calculated for these women as there were incomplete data as to the types of injuries they sustained.

The final model for severity of injuries was then applied using the total number of genital and nongenital injuries. The model fit with total injuries (χ^2 41.93, p=0.14) and all previously identified effects remained significant. The final model for total injuries is shown in Figure 3-3.

Figure 3-3. *Final Fitted Model with Total Injuries*



* p<0.05
for all other indices p<0.01

Two further modifications to the structural model were made to the model: consciousness to nongenital injury; and maturity to nongenital injury. These modifications resulted in a nonsignificant effect from penetration to nongenital injury which was then removed. The model continued to fit when the error variance was reduced to 0.05. The fit of the final model remained high and was similar to the fit with severity of injury (χ^2 31.1, p=0.51, RMSEA 0.00, GFI 0.99, NFI 0.97).

The significant unstandardized effects and new effects for this model are summarized in Table 3-6. Most were significant at probabilities of less than 0.01.

Table 3-6

Unstandardized Direct Effects of Final Model with Total Injuries

Factor Receiving Effect	Conscious-ness	Maturity	Intimacy	Privacy	Verbal Aggression	Verbal Resistance	Physical Resistance	Physical Aggression	Penetra-tion	Nongeni-tal Total
Intimacy	0.58									
Privacy of Setting			0.53							
Verbal Aggression	0.31	0.03								0.02
Verbal Resistance	0.70			0.07*						
Physical Resistance					0.15	0.35			-0.10	
Physical Aggression	1.05	0.03	-0.20*	-0.13*	0.55		0.52			
Penetration Site	1.64			0.10						
Nongenital Injuries	-2.94 (new)	0.14* (new)						2.26	ns	
Genital Injuries									0.26	

* significant at p<0.05 (remainder significant at p<0.01)

Analyses of Excluded Indicators

The influences of the indicators excluded from the conceptual model remained unknown: psychiatric disorder, disabilities, Aboriginal status, income, number of assailants, weapons and object used to penetrate. These indicators, along with all those from the initial conceptual model, were entered into a forward linear regression analysis in the order approximated in the model (Table 3-7). The only factors that entered into the regression for nongenital injury were physical aggression and physical resistance (F 18.8, p=0.00). These two risk factors accounted for 27% of the variance in nongenital injury severity scores. The beta coefficient for physical aggression was 1.8 and for physical resistance was 3.2. None of the risk factors excluded from the structural equation model emerged as significant. The regression analysis was repeated using severity of genital injury as the dependent variable. The only significant factor was the penetration site, accounting for 6% of the variance in genital injuries with a beta coefficient of 0.941. (F=7.23, p=0.008).

Table 3-7.

Indicators in Regression Model in Order of Entry

Biographic Factors	**Contextual Factors**	**Assault Factors**	**Outcomes**
Consciousness Psychiatric disorder* Disability* Race* Income* Age	Intimacy Privacy of setting	Verbal aggression Verbal resistance Physical resistance Physical aggression Weapon presence* Number of assailants* Object used to penetrate* Penetration site	Nongenital injury severity Genital injury severity

* items originally excluded in SEM model

The violations of the assumptions of normalcy were issues in the regression analyses and in the SEM, although maximum likelihood estimation in SEM is fairly robust to violations such as kurtosis. There were many outliers and large residuals for each equation. They were not, however, rejected from the regression equations permitting them to be analyzed.

Discussion

The model for severity of injury was considerably more sparse than originally hypothesized and had a few unanticipated results. It is possible that the role of the excluded risk factors (race, income, psychiatric diagnosis, disability, number of assailants and object used to penetration) may not have been obvious due to normalcy issues in the data. Further multivariate analyses are recommended using these variables before they are discounted as risk factors. There were four main research questions to be addressed in this research: the influence and relationships of risk factors on nongenital injury severity; the influence and relationships of risk factors on genital injury severity; the relationship between nongenital and genital injury; and the similarity of relationships between injury severity and injury numbers.

Influences of Risk Factors on Injury Outcomes

Nongenital Injury

Nongenital injury severity and total number of nongenital injuries were both increased if the assailant used higher levels of physical aggression such as hitting or attempted strangulation. The severity of nongenital injury was also increased with attempted penetration or oral penetration compared to completed penetration of the vagina, anus or multiple sites of penetration. The association between the penetration site and risk for nongenital injury suggests increased use of physical resistance with attempted penetration or oral penetration compared to completed penetration. The increased resistance in turn is associated with increased physical aggression and thus nongenital injury. Similarly, increased physical injury was found in a small sample of sexually assaulted women with attempted rather than completed penetration (Slaughter et al., 1997). Conversely, there was decreased physical resistance associated with completed vaginal or anal penetration or penetration of multiple sites. This would suggest women "give up" once penetration has occurred. The interaction of physical resistance and physical aggression was further supported in the multiple regression. The lower category of penetration site also includes oral penetration. Injuries that occur would affect the mouth, thus counting as nongenital injury.

Total numbers of nongenital injury were increased if the women were more alert and if they were older. The mechanism for this finding is not clear, as it would be anticipated that the impact of increased consciousness would be accounted for by increased resistance and use of increased aggression. These relationships existed but there was an additional direct effect of consciousness. There is likely an unknown concept between consciousness and nongenital injury that would explain this connection, such as increased muscle tension or the effects of catecholamines.

It was anticipated that there would be increased injuries with increased age, although this only was the case for nongenital injury. As estrogen levels decrease there is less elasticity and connective tissues under the skin, and skin becomes more fragile. Similar amounts of pressure could result in more bruising or abrasions. In addition the model also demonstrated older women were more likely to know their assailant and be in a private setting such as a home. The interaction of these factors contributes to the total injuries.

Increased nongenital injury had a reciprocal effect, leading to increased verbal aggression and potentially increasing nongenital injury further. This influence was not anticipated from the literature. It is possible that once injuries have been inflicted the assailant may become more fearful or angry, perhaps blaming the victim. Further information is needed to evaluate this influence.

Genital Injury

The penetration site was the only risk factor directly increasing the severity of genital injury and total numbers of genital injury. There were only two factors that increased the likelihood of completed penetration of vaginal or anal sites or multiple sites. These were increased levels of consciousness and increased intimacy with the assailant.

Relationships Between Risk Factors

Nongenital Injury

Physical aggression, while a main factor in nongenital injury, was influenced in turn by a number of risk factors. Increased levels of consciousness and increased physical resistance were associated with increased physical aggression. Increased physical aggression was also seen with strangers or less well known assailants. This finding is in contrast to previously reported research in which there were increased levels of aggression and severity of physical injury and genital injury with intimate assaults compared to strangers (Stermac et al., 2006). The discrepancy may be due to the lack of data on nongenital injury with various assailants. The data available describe physical injury (which includes genital injury) and genital injury. It is possible that the association between spouses and physical injury is due to an unidentified common source. The use of a separate category of nongenital injury allows an examination of the influences of factors such as resistance and levels of consciousness more closely between assailant groups. The increased physical aggression and nongenital injury associated with strangers may also be influenced by sociocultural differences. Further exploration of the data revealed that there were more Aboriginal women with nongenital injuries and that more of these women were assaulted by strangers rather than intimates.

Physical aggression was increased in more public than private settings. The more private the setting, the less physical aggression the women experienced. This is also in the opposite direction to that hypothesized, although there was little research available on settings and injuries. The reasons for this finding are unknown but may be related to a sense of futility perceived by women if they try to fight when alone and are unlikely to receive help. More well known assailants were also more likely to choose more private settings. This could be an alternate explanation as to why nongenital injuries were less likely or less severe with intimates. The women may not be attempting to resist as much in private settings.

Consciousness increased a number of risk factors indirectly associated with nongenital injury. If the women were more conscious they were more likely to be yelled at or insulted, or have threats made to their lives. They were also more likely to know their assailant and to react with stronger methods of verbal resistance. The verbal resistance in turn increased physical resistance and physical aggression. Conversely if they were less conscious there was less resistance and aggression therefore less nongenital injury. It is suggested that women would be more likely to be conscious in public versus private settings. Increased consciousness was also directly linked to increased levels of physical aggression to control them such as being hit or strangled.

Physical maturity had multiple effects as well. Older women were more likely to experience increased verbal and physical aggression by the assailant. This relationship might be explained through the likelihood that as they get older women are more likely to be involved in long term relationships and living with a partner. These women are thus at risk of chronic exposure to intimate partner violence including verbal, physical and sexual abuse. There may be other aspects in their lives that relate to increased aggression, such as substance abuse or children but these are not reflected in this study.

Genital Injury

The penetration site was the key influence on the severity and number of genital injuries. Older women were more likely to have anal penetration or multiple sites of penetration. The increased access and privacy provide more opportunities to penetrate women and to perhaps subject them to more than one type of assault or more forms of assault considered more degrading such as anal penetration.

Consciousness had a strong direct effect on the site of penetration. It had been anticipated that factors such as resistance would have an influence on penetration but were not significant. Increased levels of consciousness may contribute to increased genital injury through mechanisms not measured in the model such as decreased vaginal lubrication with fear or muscle tension in the genital region during the assault. Aspects of self-protection may also be at work, such as turning over to prevent penetration and sustaining anal penetration. This would not be captured in the resistance strategies.

Consciousness was a concept that had indirect and direct associations with both genital and nongenital injury. These findings suggest that consciousness may be a key factor to explore in prevention of genital and nongenital injury as well as risk for sexual assault. Under what circumstances are women most likely to have altered levels of consciousness and what are the implications? The reasons for the increased severity and numbers of injuries influenced by increased levels of consciousness also need to be explored further.

Limitations

The results of this study have limited generalizability unless there are similar samples of women with similar characteristics. Factors such as examiner skill and techniques also affect injury detection therefore the setting would have to be similar as well.

The need to decrease the final sample to less than half may have affected the results. The final sample appeared similar to the larger sample, but it is possible that there are systematic errors in the data as a result and that the model may not be replicated by other datasets. Generalization of the results, at best, are restricted to samples in which women agree to both genital and nongenital examinations, are seen in an Emergency setting with optional police reporting, and whom have similar risk factor characteristics.

The listwise deletion resulted in a sample size that did not allow for splitting the sample and re-estimation to confirm the model as planned. Further replication of the model is required before any confidence can be placed on the assertions in the structural portion of the model. The size of the final sample, however, was sufficient to test the initial model with 26 parameters.

Implications

There are a number of implications that come from the development and testing of the model. In clinical practice it is necessary to become familiar with the factors of interest that may lead to nongenital and genital injury, assess for their presence and document their findings. There is a need for more comprehensive and standardized definitions of injury types across examiners. Cohort studies are likely to continue as the main source of data, as randomized studies are difficult in this sensitive population. The data are therefore obtained from clinical records and databases and these need to be regularly checked for accuracy. Clinical examiners need to understand the results of this and future model estimations prior to giving testimony regarding the presence or absence of injury and its implications.

Nurse educators are responsible for interpreting the research and educating staff regarding the definitions of injury, detection of injury and implications of risk factors for genital and nongenital injury. Standardized definitions and terminology should be integrated into education sessions, ideally coordinating provincial and national terminology. Examination techniques also require standardization. There is also a need for education to collaborating personnel (e.g.-police, lawyers) regarding the role of risk factors on injuries and why injuries may be absent.

Nurse researchers need to build on existing research efforts. It is clear that risk factors act differentially on genital and nongenital injury and need to be examined as separate outcomes. Furthermore, both total injuries and severity of injuries should be examined until the differences or similarities in influences of risk factors can be identified. Use of similar or comparable indices such as the severity index is highly recommended in order to compare and contrast findings across populations. The role of consciousness in genital and nongenital injury warrants further exploration. Further study is needed on the role of the excluded risk factors: race, especially involving Aboriginal women; income; psychiatric disorder; disability; number of assailants; and the object used.

Conclusion

A model of risks for nongenital and genital injury was developed and estimated using structural equation modeling. This exploratory model confirmed that with this sample of women the risk factors have different influences on genital or nongenital injury outcomes. This finding suggests the need to study the two types of injury separately until more is known about the influences and relative contributions of the risk factors across different populations and settings. There was a common pathway between the two types of injury through the role of levels of consciousness. There was also a link between genital injury and nongenital injury through the physical resistance associated with attempted versus completed penetration. Further confirmatory testing of this model is required across different settings and sexual assault populations.

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CHAPTER 4. CONCLUSION

Discussion

Two studies were conducted for this dissertation: a systematic review of risks for injury; and testing of a conceptual model linking risk factors with injury outcomes (Carter-Snell, 2007). The purpose of these studies was to improve understanding of the rates of injuries and risk factors for injury among women who have been recently sexually assaulted. The main research questions included the following: quality of the evidence; rates and severity of injury outcomes; factors affecting variability of injury rates; the influence of various biographic, contextual and assault risk factors; and the relationships between these risk factors and injury outcomes. These questions were addressed through the use of a systematic review of the relevant literature followed by testing of a conceptual model with a sample of sexually assaulted Canadian women.

Quality of the Evidence

The study quality was relatively poor. The available research consisted solely of cohort studies and descriptions of the injuries and risk factors within these. There were only a limited number of multivariate analyses, again involving cohorts. These factors limit the ability to make inferences about the results and to examine relationships between factors.

Two different rating scales were used to assess study quality. A median score of 60% was obtained across all studies with both scales, although more recent studies involved populations or methods that were more typical of common practices and generalizable to other sexual assault settings.

Injury Rates and Severity

The rates of injury varied greatly in the systematic review. Nongenital injury rates ranged from 23 to 76% while genital injuries ranged from 5 to 85%. The exact rates were difficult to determine due to the heterogeneity of the studies. Trends were seen in both studies. In general, nongenital injuries were more common than genital injuries and were more severe. The severity of nongenital injury was increased if there was attempted penetration, likely through increased use of physical resistance. It was also rare in both studies to have genital injury without nongenital injury. These patterns were supported in the structural equation modeling with a sample of 450 women. The similarities and differences in injury outcomes are summarized in Table 4-1.

Table 4-1.

Comparison of Injury Outcomes in Systematic Review and Model/Regression Analyses

Injury Rates & Severity	**Systematic Review**	**Structural Equation Model & Regression Analysis**
Injury rates & severity	Nongenital • higher rates of nongenital injury than genital injury • more severe than genital injuries Genital • higher rate of genital injury if also had nongenital injury	Nongenital • higher rates of nongenital injury than genital • attempted penetration (linked to genital injury) increased physical resistance (increasing nongenital injury) Genital • increased levels of consciousness increased the risk of penetration as well as physical aggression, linking genital and nongenital injury indirectly)

Factors Influencing Injury Rates

The heterogeneity in the studies was due to differences in definitions of injury outcomes and types of injuries included, age groups, examiner type or skill, visualization techniques, and the setting (police reported or optional reporting). Studies with SANEs reported higher rates of genital injuries and lower rates of nongenital injuries when compared to Emergency physicians. Higher rates of genital injury were reported when toluidine or colposcopy were used to examine the genital area, and these were used predominantly by SANEs.

Influence of Risk Factors on Injury Outcomes

The key findings of both the systematic review and the conceptual model are summarized for the three groups of risk factors: biographic; contextual; and assault risk factors.

Biographic Factors

There were consistent findings between the two studies in the areas of age and consciousness. These findings are summarized in Table 4-2.

Table 4-2.

Influence of Biographic Risk Factors Across Studies

Biographic	**Systematic Review**	**Structural Equation Model & Multiple Regression**
Age	Nongenital • Adolescents women had lower rate of injury Genital • Adolescents and older adults had higher rates of injury than young adults	Nongenital • Increased total numbers of injuries with age Genital • No significant influence
Prior sexual Experience	Physical Injury • Higher risk of injury with no prior sex	• No significant influence (regression)
Race	Nongenital • White & Aboriginal women had the highest rates of nongenital injury Genital • White & Black women had the highest rates of genital injury	• No significant influence (regression)

Table 4-2 (continued)

Influence of Biographic Risk Factors Across Studies

Biographic	**Systematic Review**	**Structural Equation Model & Multiple Regression**
Psychiatric Disorder	Nongenital • Increased rates of nongenital injuries with psychiatric disorders Genital • No difference in genital injury rates	• No significant influence (regression)
Substance Use	Nongenital • Higher rates if alcohol or drugs used Genital • No difference with alcohol use	• Not analyzed
Consciousness	Nongenital • Higher rates if mildly intoxicated Genital • Lower rates if women unconscious or markedly intoxicated	Nongenital • Greater total injuries if women more awake/conscious (consciousness also increased physical aggression) Genital • Increased consciousness resulted in increased risk of completed penetration or numbers of penetration sites

Adult women had higher rates of nongenital injury and greater physical aggression than younger women. Genital injuries were more likely with increased levels of consciousness due to risk of completed penetration. Increased consciousness also increased the number and severity of nongenital injuries. The model showed this link to be due to increased physical aggression and increased physical resistance. There was no consistency of findings for the role of prior sexual experience, race, or psychiatric disorders.

Contextual Factors

Across the studies there was an increased risk of genital injury in more private settings, related most likely to the privacy of the settings (Table 4-3). The results were more inconsistent for the role of the setting in nongenital injuries. The results for the relationship to the assailant were also unclear. The systematic review suggested that there was increased force and nongenital injury with intimate assailants, while the conceptual model associated these with strangers.

Table 4-3.

Influence of Contextual Risk Factors Across Studies

Contextual Risk Factors	**Systematic Review**	**Modeling/Regression**
Intimacy	Nongenital • Higher rates of injury with intimates and known assailants (higher than genital) Genital • Higher rates of injury with intimates and known assailants	Nongenital • Increased physical aggression if the assailant was a stranger Genital • No significant influence
Privacy of setting	Nongenital • High rates of injury in vehicles Genital • Higher rates in homes vs public place	Nongenital • Increased physical aggression in more public places Genital • Increased risk of completed penetration or more than one penetration site if more private setting

Assault Factors

There were consistently higher rates of nongenital injury with increased physical aggression (Table 4-4). The nongenital injuries were more severe than nongenital injuries. One area of inconsistency was the role of multiple assailants in nongenital injury. The discrepancy may be due to the overlap between multiple assailants and the concept of increased force. Greater genital injury was not consistently found if physical resistance was used, although more nongenital injury was found in both studies with the use of physical or verbal resistance.

Table 4-4.

Influence of Assault Risk Factors Across Studies

Assault Risk Factors	**Systematic Review**	**Modeling/Regression**
Number of assailants	Nongenital • higher injury rates with multiple assailants Genital • no difference in injury rates with single or multiple assailants	• No significant influence (regression)
Resistance	Nongenital • No data Genital • Lower rates if immobilized/frozen • Higher rates if used verbal or physical resistance Physical • Lower rates if verbal resistance used • Higher rates if used physical resistance with stranger vs known assailant	Nongenital • Increased physical resistance if verbal resistance present • Increased physical aggression if physical resistance Genital • No significant influence
Aggression	Nongenital • High rates if severe force used or attempted strangulation • Increased rates if verbal resistance used Genital • Minimal difference in injury rates with physical aggression	Nongenital • Increased verbal aggression increased physical aggression Genital • No significant influence
Weapon Use	Nongenital • Higher rates if weapon present Genital • Lower rates if weapon present	• No significant influence
Penetration	Nongenital • No difference with types of penetration Genital • Higher rates of injury if anal penetration (vs. vaginal) and with attempted vs. completed penetration	Nongenital • Attempted penetration (vs. completed) increased the level of physical resistance, thus nongenital injury rates Genital • Increased severity and number of injuries with completed or multiple penetration sites

Table 4-4 (continued)

Influence of Assault Risk Factors Across Studies

Assault Risk Factors	**Systematic Review**	**Modeling/Regression**
Object Used to Penetrate	Genital • Highest rate of injury with penile penetration, then digital, lowest with foreign body	• No significant influence
Position During Assault	Position During Assault • Genital injuries – highest while standing, next by supine or multiple positions, lowest if on stomach	• Data not available
Lubrication	Genital • Higher rates if lubricant was used	• Data not available

It was evident from both the systematic review and the conceptual model that genital and nongenital injuries were influenced by different risk factors. Nongenital injury had the strongest influence from the extent of physical aggression, while genital injury had the greatest effect from the site of penetration. Even common risk factors such as consciousness exerted their influence through different indirect relationships.

Relationship between Genital and Nongenital Injury

Nongenital and genital injury were related to each other through attempted penetration in the structural equation modeling. Attempted penetration was associated with increased physical resistance, which in turn was associated with increased physical aggression. Consciousness also linked both forms of injury indirectly. When the conceptual model was re-analyzed using numbers of injuries as the outcome rather than severity there was a good fit with the addition of two more links- consciousness and maturity directly linked to nongenital injury. When this occurred the relationship between penetration site and nongenital injuries was no longer significant. These findings strengthened the importance of consciousness as a common concept between genital and nongenital injury through multiple interactions.

Implications

The results of the two studies support a need to conduct studies in which risk factors are defined with standard terms, involve similar examiner types and techniques, and similar settings. Both the systematic review and the structural equation model results have demonstrated the importance of studying nongenital and genital injury as separate outcomes rather than combining them into a physical injury outcome. These changes are required before any firm recommendations can be made from the findings.

Despite the heterogeneity, there were some consistent trends across the studies that suggest some risk factors be considered in future multivariate analyses. One of the major findings was that nongenital injuries occurred more often than genital injuries and were more severe. It was also of note that some risk factors such as age acted as risk factors differently depending on the injury outcome. These findings are important for future research. The injuries must be examined separately along with their influences. The consistency of findings between the studies suggests a number of implications for practice, education and research among sexual assault nurses, especially if supported in further research.

Practice

Only a third of women in the United States seek health care after a sexual assault (Tjaden & Thoennes, 2002). This may be due, in part, to the requirement to pay for a sexual assault examination, although Canadian data sources also reveal low rates of health seeking as well (Federal/Provincial/Territorial Ministers Responsible for the Status of Women, 2002). Clinical experience has shown that some women do not realize that they have injuries and may refuse an examination even if women do seek health care. These studies have indicated some consistent findings between many of the risk factors in the literature and a sample of Canadian women. The findings support the need to obtain detailed histories from women regarding their assault with a focus on early identification of injuries and prevention of their consequences. Factors such as physical aggression or the site of penetration were linked in both studies to injury. Knowledge of these factors will help guide nursing assessment of women who may have been injured, especially if findings are supported across studies. This information would aid nurses in counselling women regarding the importance of a physical examination and possible health consequences of the assault. Injury information and risk factors could also be used to plan services that fit women's needs following sexual assault, and guide the development of injury prevention strategies.

Education

The results emphasize a need for improved standardization among health care professionals conducting the examinations following sexual assault to facilitate future research and verification of the findings of the systematic review and structural equation modeling. Definitions of injury and injury types need to be consistent as do techniques used for examination. The implications of differences in injury identification can affect not only the woman's risks of infection but have implications in court. There have been attempts to compare the number of injuries sustained in sexual assault with those from consensual intercourse. These comparisons are meaningless if different definitions and techniques have been used. Nurses receiving court preparation need to know information regarding injury rates, severity, risks for injury and implications of injury.

There is a need for nurses to educate the community regarding injuries, including health policy makers and women's groups. Decisions are underway in many communities to move sexual assault examinations away from hospitals or health care agencies and into multidisciplinary centres with police, social work and examiners. These decisions need to be considered in relation to injury rates, severity of injury, consequences of injuries and women's need for further health care prior to discharge.

Multidisciplinary education is also required. Legal personnel and police need to be aware that at least a third of women do not have injuries and that this does not mean a sexual assault did not occur. They also need to be familiar with standardized injury nomenclature, risk factors for genital and nongenital injury and the consequences of injury.

The public also need to become acquainted with the results of this and future injury research. Family, friends and the women affected may dismiss the validity of the assault if there are not visible injuries. It is hoped that women may seek health care services for sexual assault even in the absence of known injuries, especially as they may be unaware of injuries. In this manner it may be possible to facilitate appropriate levels of intervention and support to prevent further consequences.

Research

Further research is required to confirm the effects of the risk factors and injury outcomes identified in this research with similar populations, settings, outcomes and risk factors. Use of consistent injury definitions, similar scales for injury severity and techniques for identifying injury, as well as more homogenous populations are strongly encouraged. The effects of examiner differences and techniques and age differences on variability of results were seen and should be considered in planning research or attempting to compare results such as through future systematic reviews. There is a need for well designed comparisons of injuries between women who consent to sexual intercourse and women who have been sexually assaulted. This type of research will aid in determining clinical and legal significance of injuries.

One aspect that emerged in these studies was the importance of ensuring items within a scale measure the same concept. This was seen when aggression and resistance were split into verbal and physical components. Initial attempts at convergence failed while they were kept together and it was subsequently seen that they had differential effects on injuries. For instance physical aggression had a strong direct effect on nongenital injuries, while verbal aggression had much smaller indirect effects on physical aggression and on physical resistance. Very few of the risk factors had the same effects on nongenital and genital injury. Once more this highlights the importance of studying injury outcomes separately.

Both the systematic review and structural equation modeling were focused on the pre-event and event aspects of Haddon's injury matrix. Post-event injury and illness have to be explored as well. Research is also required to identify the links between injuries and PTSD. Some of the factors identified as risks for injury have also been linked to an increased risk of posttraumatic stress disorder (Davis & Breslau, 1994), including assaults by strangers, use of a weapon, and physical aggression. It may not be the injuries themselves but the risk factors that link injury and PTSD. Again, the mechanisms underlying both have to be understood before effective prevention can take place.

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APPENDIX A: DETAILED INJURY DATA

Presence of "Physical" Injury (Genital, Nongenital or Both)

Author	Injured/N	Percent	Percent CI (95%)
Bownes (1991)	19/51	37	24-51
Del Bove (2005) GroupA	40/61	66	54-77
Del Bove (2005) GroupB	48/73	66	55-77
Del Bove (2005) Group-C	59/78	76	66-85
Du Mont (2003)	104/172	60	53-68
Goodyear-Smith (1989)	61/81	75	66-85
Millar (2002)	380/1118	34	31-37
Muram (1995) GroupA	30/113	27	18-35
Muram (1995) GroupB	83/195	43	36-50
Penttila (1990)	224/249	90	86-94
Ramin (1992)	178/258	69	63-75
Read (2005)	350/521	67	63-71
Ruback (1988)	91/182	50	43-57
Satin (1991) GroupA	49/114	43	34-52
Satin (1991) GroupB	72/114	63	54-72
Sommers (2006)	82/120	68	60-77
Stermac (1995) GroupA	167/221	76	70-81
Stermac (1995) GroupB	284/456	62	58-67
Stermac (2001)	383/547	70	66-74
Stermac (2006)	645/1004	64	61-67
Tintinalli (1985)	119/372	32	27-37
Ullman (1999) GroupA	420/1269	33	31-36
Ullman (1999) GroupB	187/550	34	30-38

Appendix A: Detailed Injury Data (Continued)

Presence of Nongenital Injury -All

Author	Injured/N	Percent	Percent CI (95%)
Anderson (2006)	11/56	20	9-30
Jones (2003)	78/204	38	32-45
Slaughter (1997)	178/311	57	52-63
Crane (2006) GroupA	461/620	74	71-78
Crane (2006) GroupB	393/1602	25	22-27
Crane (2006) GroupC	530/1096	48	45-51
Jones (2003b) GroupA	109/329	33	28-38
Jones (2003b) GroupB	241/437	55	50-60
Jones (2004) GroupA	145/238	61	55-67
Jones (2004) GroupB	244/611	40	36-44
Satin (1991) GroupA	45/114	39	31-48
Satin (1991) GroupB	61/114	54	44-63
Stermac (1995) GroupA	116/221	52	46-59
Stermac (1995) GroupB	179/456	39	35-44
Adams (2001)	123/214	57	51-64
Cartwright (1987)	162/405	40	35-45
Cartwright (1989)	11/21	52	31-74
Eckert (2002)	425/819	52	48-55
Goodyear-Smith (1989)	52/81	64	54-75
Hilden (2005)	26/80	33	22-43
Lenehan (1998)	13/17	76	56-97
Olusanya (1986)	39/171	23	17-29
Palmer (2004)	70/153	46	38-54
Penttila (1990)	180/249	72	67-78
Ramin (1992)	148/258	57	51-63
Read (2005)	233/482	48	44-53
Rodenas (1989)	20/86	23	14-32
Schei (2003)	94/156	60	53-68
Sommers (2003)	69/120	58	49-66
Sugar (2004)	425/819	52	48-55
White (2006) GroupA	39/79	49	38-60
White (2006) GroupB	54/95	57	47-67

Appendix A: Detailed Injury Data (Continued)

Presence of Genital Injury -All

Author	Injured/N	Percent	Percent CI (95%)
Adams (2001)	138/214	64	58-71
Anderson (2006)	18/56	32	20-44
Biggs (1998) GroupA	43/66	65	54-77
Biggs (1998) GroupB	17/68	25	15-35
Bowyer (1997)	22/83	27	17-36
Cartwright (1986)	70/440	16	12-19
Cartwright (1987)	65/405	16	12-20
Cartwright (1989)	11/21	52	31-74
Crane (2005) GroupA	423/620	68	65-72
Crane (2005) GroupB	1242/1602	78	75-80
Crane (2005) GroupC	230/1096	21	19-23
Eckert (2002)	193/819	24	21-26
Goodyear-Smith (1989)	38/81	47	36-58
Hilden (2005)	80/249	32	26-38
Jones (2003) GroupA	173/204	85	80-90
Jones (2003) GroupB	37/51	73	60-85
Jones (2003b) GroupA	273/329	83	79-87
Jones (2003b) GroupB	280/437	64	60-69
Jones (2004) GroupA	183/238	77	72-82
Jones (2004) GroupB	434/611	71	67-75
Lenehan (1998)	9/17	53	29-77
Olusanya (1986)	28/171	16	11-22
Palmer (2004)	33/153	22	15-28
Penttila (1990)	45/249	18	13-23
Ramin (1992)	78/258	30	25-36
Read (2005)	276/479	58	53-62
Rodenas (1989)	24/86	28	18-37
Rossman (2000) GroupA	65/82	79	70-88
Rossman (2000) GroupB	243/328	74	69-79
Rossman (2004)	43/53	81	71-92
Ruback (1988)	17/182	9	5-14
Sachs (2002)	169/209	81	76-86
Satin (1991) GroupA	6/114	5	1-9

Appendix A: Detailed Injury Data (Continued)

Presence of Genital Injury –All (continued)

Author	Injured/N	Percent	Percent CI (95%)
Satin (1991) GroupB	24/114	21	14-29
Schei (2003)	30/156	19	13-25
Schiff (1979)	8/100	8	3-13
Schiff (1979)	31/100	31	22-40
Slaughter (1997)	213/311	68	63-74
Sommers (2006)	54/120	45	36-54
Sugar (2004)	165/759	22	19-25
White (2006) Group A	43/69	62	51-74
White (2006) GroupB	31/67	46	34-58

APPENDIX B: SAMPLE COMPARISONS-RISKS AND OUTCOMES

Continuous Risk Factors

Indicator	Full Sample Mean (SD)	SEM Sample Mean (sd)*
Age	24.5 (9.5)	24.4 (9.8)
Hours since assault	21.7 (32.3)	22.5 (33.0)
Average female income	20049.92 (4626.58)	20151.33 (5033.17)
Number of assailants	1.2 (0.8)	1.2 (0.6)
Physical aggression	2.7 (2.5)	2.4 (2.4)
Total nongenital injuries	9.7 (11.7)	10.2 (13.0)
Severity nongenital injuries	11.0 (17.9)	11.6 (21.6)
Total genital injuries	2.4 (2.5)	2.5 (2.6)
Severity genital injuries	3.5 (5.5)	3.6 (5.3)

* all SEM values were within bounds of 95% confidence intervals

Categorical Risk Factors

Indicator (Full N, SEM N)	Categories	Full Sample n (%)	SEM Sample n (%)	SEM value < or > 95% CI
Police reported	Yes	665 (65.7)	339 (69.9)	--
(1005, 485)	No	340 (34.3)	146 (30.1)	--
Race	White	470 (66.8)	243 (50.1)	--
(703, 342)	Aboriginal	194 (27.6)	77 (22.5)	Lower
	Other minorities	39 (5.6)	22 (6.4)	--
Behaviour	Drowsy or flat affect	87 (8.8)	42 (8.8)	--
(987, 480)	Quiet	269 (27.2)	123 (25.6)	Lower
	Conversational	573 (58.0)	287 (59.8)	--
	Agitated	200 (20.3)	98(20.4)	--
Consciousness	Unconscious	288 (29.1)	124 (25.6)	Lower
(990, 485)	Drowsy	186 (18.8)	103 (21.2)	--
	Alert-awake	516 (52.1)	258 (53.2)	--
Prior sex experience	None	48 (5.0)	18 (3.8)	Lower
(962, 472)	Not in last 7 days	565 (58.7)	286 (60.6)	--
	Within last 7 days	349 (36.3)	168 (34.6)	Lower
Psychiatric disorder	None	297 (54.6)	143 (55.6)	--
(544, 257)	Possible	119 (21.9)	49 (19.1)	Lower
	Diagnosed disorder	109 (20.0)	55 (21.4)	--
	Suicide attempts	19 (3.5)	10 (3.9)	--
Disability	None	859 (97.1)	428 (88.2)	Lower
(885, 444)	Cognitive disability	17 (1.9)	9 (1.9)	--
	Physical disability	6 (0.7)	5 (1.0)	--
	Both disabilities	3 (0.3)	2 (0.4)	--
Intimacy	Patient can't recall	156 (16.1)	56 (11.6)	Lower
(974, 485)	Stranger	139 (15.3)	65 (13.4)	--
	Acquaintance < 24 hrs	287 (29.5)	148 (30.5)	--
	Acquaintance > 24 hrs	289 (29.7)	155 (32.0)	--
	Family	24 (2.5)	10 (2.1)	--
	Intimate partner	69 (7.1)	35 (7.2)	--

Appendix B: Sample Comparisons (continued)

Categorical Variables (continued)

Indicator (Full N, SEM N)	**Categories**	**Full Sample n (%)**	**SEM Sample n (%)**	**SEM value < or > 95% CI**
Privacy (977, 485)	Unknown by patient	128 (13.1)	55 (11.6)	Lower
	Public place	70 (7.2)	35 (7.2)	--
	Outdoors	123 (12.6)	52 (10.7)	Lower
	Multiple places	11 (1.1)	8 (1.7)	--
	Vehicle	95 (9.7)	49 (10.1)	--
	House	550 (56.3)	285 (58.8)	--
Verbal aggression (898, 485)	None	311 (34.6)	196 (40.4)	--
	Possible	351 (39.1)	148 (30.5)	Lower
	Coerced-pleaded	89 (9.9)	58 (12.0)	--
	Insulted-yelled	59 (6.6)	33 (6.8)	--
	Threatened life	87 (9.7)	50 (10.3)	--
Verbal resistance (814, 485)	None	61 (7.5)	51 (10.5)	--
	Can't recall	340 (41.8)	145 (29.9)	Lower
	Immobilized	31 (3.8)	27 (5.6)	--
	Asked to stop	297 (36.5)	204 (42.1)	--
	Yelled-screamed	85 (10.4)	58 (12.0)	--
Physical resistance (865, 485)	None	255 (29.2)	170 (35.1)	--
	Can't recall	368 (43.0)	163 (33.6)	Lower
	Immobilized	35 (4.1)	21 (4.3)	--
	Fought/ran	203 (23.7)	131 (27.0)	--
Weapon present (956, 481)	None	595 (62.2)	335 (69.7)	--
	Unknown	300 (31.4)	111 (23.1)	Lower
	Weapon present	43 (4.5)	24 (5.0)	--
	Weapon used	18 (1.9)	11 (2.3)	--
Object used (995, 484)	Uncertain	292 (29.3)	118 (24.4)	Lower
	External fondling	10 (1.0)	4 (0.8)	--
	Foreign body	4 (0.4)	2 (0.4)	Higher
	Fingers	31 (3.1)	19 (3.9)	--
	Penis	511 (51.4)	264 (54.6)	--
	> 1 object	147 (14.8)	77 (15.9)	--
Penetration (1002, 485)	Uncertain	305 (30.4)	122 (25.1)	Lower
	Attempted	6 (0.6)	4 (0.8)	Higher
	Oral	14 (1.4)	3 (0.6)	Lower
	Vaginal	420 (41.9)	212 (43.7)	--
	Anal	16 (1.6)	9 (1.9)	--
	> 1 site (no anal)	125 (12.5)	71 (14.6)	--
	>1 site (with anal)	116 (11.6)	64 (13.2)	--

Appendix B: Sample Comparisons (continued)

Rates of Injury in Samples

Any Injury	**Full Sample (%)**	**Final Sample**
All nongenital injuries	873/965 (90.5)	446/485 (91.2)
All genital injuries	729/971 (75.1)	370/115 (76.2)
Exclusive Categories		
Neither genital or nongenital injury	35/1005 (3.5)	14 (2.9)
Nongenital injury only	192/1005 (19.1)	25 (5.2)
Genital injury only	57/1005 (5.7)	115 (23.7)
Both genital and nongenital injury	647/1005 (64.4)	331 (68.2)
Refused either genital or nongenital exam	74/1005 (7.4)	N/A